1983 Graduating Seniors Facing Dim Prospects for Employment

By Susan G. Foster

The job market for the 2.8 million members of the Class of 1983—of whom more than 1 million will be looking for full-time work—is expected to be far worse than any in more than 35 years, despite a slight upturn in the nation's ailing economy.

Further squeezed by prolonged and record-high unemployment among the nation's adult workers, this summer's job prospects will be "the bleakest" of all for the nation's high-school graduates, labor experts are predicting.

Those seasonal jobs that have traditionally been reserved for inexperienced workers of high-school and college age are now being earmarked in part for older unemployed workers who have been displaced by plant closings and the nation's economic slowdown.

As was the situation last year, federal and privately sponsored employment programs are being maintained on smaller budgets with an even greater emphasis on the involvement of the private sector.

However, most experts agree that business and industry will be unable to provide support on a scale large enough to counter an overall youth unemployment rate of 23.4 percent (49 percent for minority groups). Out-of-work young people constitute nearly a quarter of the nation's 11.3 million unemployed.

Although the Reagan Administration has approved a new tax incentive for employers who hire disadvantaged youths for the summer, few employers are likely to participate, some experts say, because it has been poorly marketed.

The Bureau of Labor Statistics estimates that 26.6 million youths between the ages of 16 and 24 will be either working or looking for work this summer, a decline of 800,000 below last year's level.

But despite the overall decline in the size of the youth population, the number of young people looking for work will far exceed the number of available jobs, agrees Michael Brown of the U. S. Conference of Mayors.

"There will be more jobs created," Mr. Brown said. "But even so, the gap is still enormous. We've had an unemployment rate of over 10 percent for much of this year."

A survey of 40 cities conducted by the U.S. Conference of Mayors found that many expect an increase in the number of full- and part-time jobs available for teen-agers. But, they also anticipate some problems this summer because of high youth-unemployment rates and inadequate program funding.

Increased Drop-Out Rates

Last year, according to the survey, the city officials reported increased school-drop-out rates and incidences of vandalism, which they attributed to the lack of summer programs to serve youths. In Detroit, the survey noted, about 40,000 youths were without summer jobs last year, and the same number are likely to be unemployed this year.

This year, the U. S. Conference of Mayors found that 37 percent of the city officials responding to the survey anticipate an increase in private-sector jobs; 50 percent said that about the same number as last year will be available; and 13 percent expect that fewer youths will be hired by business.

"Every city will say that the private sector pitched in and helped [last year]," according to Mr. Brown. "I don't think there's any city that doesn't have involvement of the private sector. The question is on what scale and does it make a difference."

"So many [businesses] have laid off workers, and they have so many laid-off workers waiting to return, that they have not been able to create jobs for youth," Mr. Brown explained.

Laurie Strumpf, assistant director of the National Association of Private Industry Councils agrees that the employment problems for youth this summer will be abetted by high unemployment among adults. "On a whole, what we're battling is that we're still in a bad economy," she said.

"You have young people being pitted against adults, and the problem is that businesses can't afford to hire anyone," Ms. Strumpf said.

Despite the economy, according to Ms. Strumpf, "there's more involvement [by the private sector] this summer than in a long time."

Among the cities surveyed that expect an increase in private-sector jobs this summer, the optimism is largely due to the Targeted Jobs Tax Credit, which was enacted by the Congress last year. Under that law, employers who hire eligible youths during the summer months will be allowed to deduct up to 85 percent of each $3,000 they pay in wages, according to Alan Lafferman, staff associate for the Interstate Conference of Employment Securities Agencies Inc., which represents employment-services agencies in the 50 states, Puerto Rico, the Virgin Islands, and the District of Columbia.

But efforts to promote the program among the nation's small and medium-sized businesses have been hampered because of insufficient funding, Mr. Lafferman said, adding that "in the few states we've been able to reach, there has been terrific response."

To generate increased summer-employment opportunities for youth, the National Alliance of Business (N.A.B.) has been encouraging executives in business and industry to create jobs. The organization's efforts are in addition to this year's $783-million allocation for the summer youth-employment program under the Comprehensive Employment and Training Act.

In some cities that started their first private-sector campaign with modest goals last year, according to Jane Herzog, N.A.B.'s director of program assistance, the results surpassed all expectations. And with the tax incentive, she contended, there will be even more jobs available. "It's a substantial savings and we feel it will be tremendously significant."

But she acknowledged that there would be problems finding jobs for youths "as long as we must deal with the displaced worker."

"The general impression most people have of the last recession has been adult-oriented," said Andrew M. Sum, director of the Center for Labor Market Studies at Northeastern University.

58 Percent Job Loss

But since the recession, he pointed out, about 96 percent of the net loss in jobs has been absorbed by young people. And about 58 percent of the job loss has been among teen-agers specifically, he noted.

The number of teen-agers in the armed services, which in the past have recruited heavily among young people, has also declined, according to Mr. Sum. In 1981, there were 308,000 teen-agers in the military, and now, he explained, the number has fallen by about 10 percent to 276,000.

"The effect of the economy's slow growth has really been devastating," Mr. Sum asserted. "We're finding that there are more than a million young people out of the labor force who want jobs but don't believe they can get one."

Those discouraged young people, according to Mr. Sum, are not even represented in the unemployment rate. He contends there has been "a huge" withdrawal of young people from the labor force.

In fact, he said, more than one million young people who were expected by labor experts several years ago to enter the work force are simply missing from it today. "We thought there would be a participation rate of more than 60 percent," he said, but the proportion of young people employed or looking for work is now about 53 percent.

"The sad thing is that the Congress, which is normally sensitive to youth-employment problems, has not acted to improve funding," Mr. Sum said. In general, he said, little attention has been given to the severity of youth unemployment.

Although the economy is slowly taking an upward turn, the improvement will not necessarily alleviate youth unemployment, noted Ms. Herzog of the N.A.B.

And because young people's lack of skills and experience create additional barriers to their employment, she said, "we will have to look for institutional rather than economic solutions."

CAREER EDUCATION FOR THE HANDICAPPED

One-Week Summer Workshop
Aug. 1- 5, 1983

Learn how to plan and implement a career education program for your school or district. Develop an action plan; earn certification as a consultant/inservice leader. Receive trainer's manual and kit; become part of national network.

Interpreted for the deaf.

Instructor: Judy Egleston-Dodd
Coordinator, National Project on Career Education

Write: Judy Egleston-Dodd
Graduate Studies Office
Graduate School of Education and Human Development
University of Rochester
Rochester, NY 14627.

School Enrollment and Labor Force Status of 1982 High-School Graduates And 1981-82 High-School Dropouts

16 to 24 Years Old, By Sex and Race, October 1982
(Numbers in Thousands)

Characteristics	Civilian Noninstitutional Population	Civilian Labor Force				
		Number	Participation Rate	Employed	Unemployed Number	Unemployed Percent
Total, 1982 High-School Graduates	**3,100**	**1,952**	**63.0**	1,512	**440**	**22.5**
Men	1,508	976	64.7	769	207	21.2
Women	1,592	976	61.3	743	233	23.9
White	2,644	1,708	64.5	1,383	325	19.0
Black	384	211	54.9	99	112	53.0
Hispanic	174	99	57.0	65	34	34.3
Enrolled in College	**1,568**	**695**	**44.3**	586	**109**	**15.7**
Men	739	316	42.8	270	46	14.6
Women	829	379	45.7	316	63	16.6
Full-Time Students	1,419	577	40.6	483	94	16.3
Part-Time Students	149	118	79.2	103	15	12.7
White	1,376	635	46.1	540	95	15.0
Black	140	42	30.0	28	14	[2]
Hispanic	75	25	33.3	22	3	[2]
Not Enrolled in College	**1,532**	**1,257**	**82.0**	926	**331**	**26.3**
Men	769	660	85.8	499	161	24.4
Women	763	597	78.2	427	170	28.5
White	1,268	1,073	84.6	843	230	21.4
Black	244	169	69.3	71	98	58.0
Hispanic	99	74	74.7	43	31	[2]
Total, 1981-82 High-School Dropouts[1]	**668**	**421**	**63.0**	246	**175**	**41.6**
Men	355	272	76.6	154	118	43.4
Women	313	149	47.6	92	57	38.3
Single	216	109	50.5	67	42	38.5
Other Marital Status	96	40	41.7	25	15	[2]
White	513	344	67.1	220	124	36.0
Black	135	70	51.9	20	50	[2]
Hispanic	73	45	[2]	26	19	[2]

[1] Persons who dropped out of school between October 1981 and October 1982. In addition, 59,000 persons 14 and 15 years old dropped out of school during this period.
[2] Data not shown where base is less than 75,000.
Note: Detail for the above race groups will not equal totals because data for the "Other Races" group are not presented and Hispanics are included in both the white and black population groups. Because of rounding, sums of individual items may not equal totals.
Source: Bureau of Labor Statistics

the Sign of a PROFESSIONAL

N C T M

LOOK FOR IT IN YOUR SCHOOLS

National Council of Teachers of Mathematics
1906 Association Dr. • Reston, VA 22091 • 703/620-9840
Publisher of ARITHMETIC TEACHER & MATHEMATICS TEACHER

Education Emerging as Presidential Campaign Issue

Continued from Page 1

less you get people stirred up whose kids are in school," said one Republican Senate aide.

President Reagan's latest move involves the issue of merit pay for teachers, a notion N.E.A. has strongly opposed. During an address at Seton Hall University in May, Mr. Reagan said that "teachers should be paid and promoted on the basis of their merit and competence."

"Rewarding excellence," he added, is "opposed by some of the heaviest hitters in the national education lobby."

The President also wrote to the N.E.A. president, Willard H. McGuire, expressing "surprise" that the N.E.A. had accused Mr. Reagan of mounting a " 'disgraceful assault on the teaching profession.' "

"Until N.E.A. supports badly needed reforms in salary, promotion, and tenure policies, the improvements we so desperately need will only be delayed," the letter said.

The May 26 letter also said Mr. Reagan was "heartened" by the master-teacher proposal developed by the Governor of Tennessee and "disappointed" at the N.E.A.'s "vigorous opposition" to the plan, which a state Senate committee rejected.

The N.E.A.'s allegation was "blatant hyperbole of the first rank," said Gary L. Jones, undersecretary of education.

The union official responded by accusing Mr. Reagan of "ignor[ing] many of the commission's findings and add[ing] concepts the Commission never addressed." He also asked to meet with the President.

"They're going to try to paint the N.E.A. into a corner," said one observer. "They want it to appear that the President is for parents, for children, for education, and the N.E.A. is just a union, for itself."

An N.E.A. staff member responded, "Making education a national issue—that's what the N.E.A. has always wanted." The staff member asked not to be identified.

Since the excellence commission's report was issued in late April, President Reagan has repeatedly stated his concern for improving the schools, even as he has reasserted support for tax credits, vouchers, and school prayer. Mr. Reagan has also sought to downplay his initial stance against federal funding of education, asserting to a group of high-school valedictorians recently that "there haven't been cutbacks in funding for public education." *(See Education Week, June 1, 1983.)*

But his public statements in support of improving education actually began in his January State of the Union Message, when he called on "parents, teachers, grassroots groups, organized labor, and the business community" to "revitalize American education by setting a standard of excellence."

And the Administration, which had asserted in a policy paper in August 1981 that "the federal government does not have responsibility for education," has moderated that stance considerably. In the fiscal 1983 budget proposed by the budget office, education programs were slated to be cut from about $14 billion to $8.3 billion. For 1984, the Administration raised the recommended figure to $13.2 billion.

The federal government, Mr. Reagan said in the Seton Hall speech, can "help set the national agenda for excellence in education."

As part of Mr. Reagan's new posture regarding education, he will appear at "some" of the 20 regional meetings scheduled around the country in the next few months, at which the excellence commission's report will be discussed, according to sources.

"The political climate is such that the White House cannot be anti-education," said August W. Steinhilber, associate executive director of the National School Boards Association. "They watched their science-education bill be increased to $425 million instead of $50 million; they watched the Senate vote an additional $1 billion for education. At the same time, they're watching the Democratic party play marvelously off education." Mr. Steinhilber also observed that the strategy "is designed to appeal to school-board members. There's a definite attempt to have a pro-public-education posture."

Edward Anthony, director of the office for educational assistance of the U. S. Catholic Conference, said the strategy was likely also to "make some points with Catholic educators."

Catholic parents and educators have favored tuition tax credits and restoring prayer in public schools, but they also support federal aid to education, especially for the Chapter 1 program for disadvantaged children, Mr. Anthony said.

The Administration's efforts to shift the focus of the debate over school quality from the federal government to local schools is likely to be assisted by investigative hearings planned for later this year by the Senate Labor and Human Resources Committee.

Congressional education committees generally oversee the implementation of federal programs in the schools; they seldom exercise their right to investigate local schools' practices.

The Senate committee, however, intends to examine some common school practices. Included among the topics, according to a committee aide, are: the impact of collective-bargaining agreements on school curriculum, the impact of states' legislative mandates, and the extent of public participation in education.

The investigation, according to the staff member, is likely to "point up that the problem is not federal money, the problems are really state and local ones."

DATABANK

1980-81 Graduates of Public High Schools
(Ranked by State as a Percentage of Grade Enrollment Four Years Earlier)

State	1980-81 graduates	9th grade enrollment 4 years earlier	Graduates as a percent of 9th grade enrollment
Total 50 states and D.C.	**2,724,564**	**3,779,486**	**72.1**
Minnesota	63,247	73,509	86.0
North Dakota	9,924	11,687	84.9
Iowa	42,635	50,297	84.8
South Dakota	10,385	12,549	82.8
Wisconsin	67,743	82,264	82.3
Nebraska	21,411	26,325	81.3
Montana	11,634	14,384	80.9
Kansas	29,397	36,510	80.5
Utah	19,886	24,800	80.2
Wyoming	6,161	7,706	80.0
Hawaii	11,472	14,415	79.6
Pennsylvania	144,645	183,933	78.6
Ohio	143,503	182,955	78.4
New Hampshire	11,552	14,989	77.1
Oklahoma	38,875	50,542	76.9
Idaho	12,679	16,509	76.8
Massachusetts	74,831	97,423	76.8
Nevada	9,069	11,808	76.8
New Jersey	93,168	121,501	76.7
Colorado	35,869	46,902	76.5
Vermont	6,424	8,510	75.5
Indiana	73,381	97,440	75.3
Washington	[1]50,046	66,469	75.3
Maryland	54,050	72,046	75.0
Arkansas	29,577	39,563	74.8
Missouri	60,359	81,548	74.0
West Virginia	23,580	31,849	74.0
Virginia	67,126	91,623	73.3
Illinois	136,795	186,984	73.2
Rhode Island	10,719	14,715	72.8
Delaware	7,349	10,111	72.7
Michigan	124,372	171,649	72.5
New Mexico	17,934	24,947	71.9
Maine	15,554	21,795	71.4
Connecticut	38,369	53,970	71.1
Oregon	28,629	40,744	70.3
Arizona	28,416	41,153	69.0
South Carolina	38,338	55,731	68.8
Texas	171,665	249,397	68.8
Alaska	5,343	7,779	68.7
California	242,172	356,094	68.0
Kentucky	41,714	62,003	67.3
Alabama	44,894	66,899	67.1
North Carolina	69,601	103,751	67.1
Tennessee	50,756	76,133	66.7
New York	198,486	301,129	65.9
Georgia	62,963	97,936	64.3
Florida	88,755	139,272	63.7
Louisiana	46,199	72,900	63.4
Mississippi	28,083	45,452	61.8
District of Columbia	4,848	8,886	54.6

[1] Estimated by NCES

Source: National Center for Education Statistics

High Court Rules in Title I Case

Continued from Page 1

At issue in the case, *Bell* v. *New Jersey and Pennsylvania*, was the authority of the department to recover funds paid to states that were determined, through audits, to have "misapplied" them under the terms of Title I of the Elementary and Secondary Education Act of 1965 (E.S.E.A.). (Title I was renamed Chapter 1 in the Education Consolidation and Improvement Act of 1981.)

In a unanimous decision written by Associate Justice Sandra Day O'Connor, the Court reversed a 1981 decision by the U. S. Court of Appeals for the Third Circuit, which said the improper expenditures occurred before the federal government had explicit statutory power to recover them under the General Education Provisions Act of 1978 (G.E.P.A.).

(The U. S. Court of Appeals for the Fourth Circuit reached the opposite conclusion in a case involving West Virginia. The court ordered the state to return to the federal government $125,000 of a 1975 Title I grant.)

In 1980, the department had ordered the two states to return Title I funds based on earlier audits showing that between 1967 and 1973 the states had spent their allocations on some schools that did not qualify for the aid.

Both states took the position that the department could deny future funds but could not apply the 1978 amendments retroactively to force the states to repay funds already spent.

The Court rejected this argument. ". . . [I]t is hardly likely that Congress intended disadvantaged children to suffer twice: once when the State misspent the funds and once when the State cancels an otherwise eligible program because of the Secretary's refusal to fund it," Justice O'Connor wrote in a footnote.

The Education Department said the 1978 amendments were retroactive; but the Court did not address that issue, ruling instead that the department's authority to recover the misspent funds existed already in the provisions of section 207(a)(1) of E.S.E.A. and section 415 of G.E.P.A.

These sections required the federal government to take into account or make adjustments for any overpayment or underpayment in previous grants.

The Court also rejected New Jersey's argument that imposing liability for misused funds interferes with state sovereignty and violates the 10th Amendment.

"Requiring states to honor the obligations voluntarily assumed as a condition of federal funding before recognizing their ownership of funds simply does not intrude on their sovereignty," the opinion states.

The case will now go back to the Third Circuit for a hearing on the issue of whether the states actually misspent the Title I funds.

ATHLETICS

Faced with a severe shortage of high-school athletic coaches, New Jersey education officials are considering a proposal to relax the state's hiring procedures.

Carl I. Johnson, the manager of the state's certification program, said officials have not ascertained the extent of the problem but they know it is a recurring concern to local administrators. One district has 44 coaching vacancies, he noted.

Last week, the state board of education considered a proposal that would allow districts to recruit coaches from throughout the state. Under current regulations, districts must recruit in their area before expanding the search.

The changes would also allow districts to hire coaches who have only substitute teaching certification if they fail to find a qualified coach with full certification.

Increases in the average age of teaching staffs and in the number of after-school activities are responsible for the shortage, said Mr. Johnson.

Officials for the National Federation of State High School Associations said they did not have any statistics to indicate whether there is a shortage nationwide.

□

Scholastic coaches are confident about their ability to cope with the situations that often lead to malpractice suits, but they are uneasy about their ability to deal with litigation.

That is the tentative conclusion of a survey of high-school athletic directors and coaches in Arkansas and Texas conducted by James Boyd, the chairman of the education department at Tarlton State University in Stephenville, Tex.

Mr. Boyd said the survey's results, which will be included in a book about coaches and legal issues, also indicate that schools must pay greater attention to the hiring of trainers, the licensing of coaches, and measures to prevent accidents.

The coaches' confidence in their training and coaching practices may not be well founded, Mr. Boyd said. Many football coaches were satisfied with their training even though methods of tackling were not adequately covered, he said. "[Training] has to be more than running," he said.

Some 286 athletic directors and coaches responded to the survey. Most of the respondents were athletic directors, who surveyed their coaches' procedures and sent results to Mr. Boyd.

□

The West Virginia Board of Education will vote this week on a proposed rule that would strictly limit the way high-school players and coaches train during the off-season.

Under the rule—which was defeated last year—coaches would not be allowed to supervise summer sports programs in which a majority of their players took part. The coaches would also be prohibited from requiring their players to take part in off-season activities.

The rule, which has been approved by the Secondary School Activities Commission, states that "student specialization is not a goal" of interscholastic sports. —C.E.

R4800-2

SETTING TRENDS

The California and Florida legislatures have enacted sweeping education-reform bills that include merit-pay plans for teachers, more money for schools, and stiffer requirements for students. And Illinois has adopted a record tax increase that will bolster aid to education.

See Page 7.

A SPECIAL REPORT

We are sending you this copy of *Education Week* because we believe you will find the 64-page report it contains on mathematics and science education of interest. It includes articles on teachers, students, and curricula; on private schools and colleges; on computers; and on foreign competition. And it features a survey of initiatives in all 50 states and the viewpoints of a panel of experts in the field.

Begins Opposite Page 8.

EDUCATION WEEK

American Education's Newspaper of Record Volume II, Number 39 · July 27, 1983

© 1983 Editorial Projects in Education

Federal, State Partnership Role Called Strong

Report to Congress Cites 'Robust' System

By Peggy Caldwell

Federal involvement in education has helped strengthen the policymaking capacity of state education agencies and has not been as severe an administrative burden on the states as is commonly believed, according to a report presented last month to the House Budget Committee's Task Force on Education and Employment.

The study, prepared by the Educational Testing Service (E.T.S.) under contract to the U. S. Education Department's School Finance Project, found state-federal relations concerning education programs to be "robust, diverse, and interdependent" in the eight states studied in 1981-82. And tensions between state and federal agencies are restricted to a few specific programs' requirements, according to the report, entitled "The Interaction of Federal and Related State Education Programs."

"We did not see states passively administering federal education programs, nor did we see states reluctant to tackle educational agendas of their own—some of which reflected federal objectives, and others of which did not," the E.T.S. researchers wrote in an executive summary of the study.

But the state agencies remained heavily dependent on federal funds for agency operations, the study found, and most federal objectives would not find broad political support in the states if the federal role in financing instructional programs and protecting special-needs students were greatly diminished.

In presenting the findings to the Congressional task force, Mary T. Moore, an E.T.S. research scientist who acted as project director, said that the federal government can play a significant role in educational improvement "by setting national agendas for both state and local action and by providing federal dollars for educational improvement to ease strained state budgets."

"I frankly am surprised with the finding of this report and [a similar report prepared by S.R.I. International, a research firm]," said Representative Pat Williams, Democrat of Montana. "They indicate that both the federal government and the states have had a powerful role in deciding the direction of education policy and that the federal role has not been inappropriate and in fact has

Continued on Page 12

Shift to Private Schools Predicted With Tax Credit

Study Finds Interest High Among Blacks, Hispanics

By Eileen White

WASHINGTON—About 5 percent of the students currently attending public schools would be likely to transfer to private schools if a tuition tax credit of $250 were available, according to a Congressionally mandated study of private schools.

The study also found that black, Hispanic, and low-income students, students whose parents attained low levels of education, and urban residents were most likely to make the change.

For story on U.S. Supreme Court's tax-deduction decision, see page 9.

And it concluded that private-school tuition cost was the principal deterrent to parents who had considered switching from public to private schools.

The report, "Private Elementary and Secondary Education," is the second part of a four-volume study known as the School Finance Project, which was mandated by the Congress in 1978 and conducted by the National Institute of Education.

Its findings are considered likely to contribute to the debate over tuition tax credits because they represent the first attempt by a research organization to estimate the effects of tuition tax credits through the use of a telephone survey and realistic cost and supply data, according to researchers familiar with the study.

The 1982 Gallup Poll on education reported that 45 percent of public-school parents would switch to private schools, but those responses were based on the assumption that students could attend private schools tuition-free. Other researchers have estimated that up to 16 percent of public-school students would transfer to private schools; their findings, however, were based on empirical evidence of private-school demand without consideration of the supply of places in private schools.

The school-finance report was completed in time for its scheduled presentation to the Congress in March. But the Reagan Administration ordered it revised, and a new version, completed early in June, has not been released. A copy of this later version was obtained by *Education Week*.

The Administration, according to informed sources, ordered the researchers to delete those portions of the report that estimated the cost of tuition tax credits to the federal treasury and the impact on the public schools of the loss of millions of students.

That information was deleted, although the law that established the study, the Education Amendments of 1978, specified that the study was to conduct "an analysis of current and future federal assistance for nonpublic elementary and secondary education, including . . . the impact of private schools on public-school enrollments and financial support."

Two Congressional education leaders wrote to the Secretary of Education early this month seeking copies of the study. According to aides to the legislators—Representative Carl D. Perkins, Democrat of Kentucky, and Senator Robert T. Stafford, Republican of Vermont—they have not received replies.

Education Department sources said that the Administration was reluctant to release even the revised version of the report because, although its findings appear to support President Reagan's statement that tuition tax credits would "help low- and middle-income families afford the schools of their choice," they also show the Administration's estimate of the cost of tuition tax

Continued on Page 14

'It May Be a Blessing in Disguise'

Reagan's Merit-Pay Advocacy Catches N.E.A. Off Guard

By Thomas Toch

President Reagan's campaign on behalf of merit pay, now more than eight weeks old, has thrown the leadership of the National Education Association (N.E.A.) off balance and has provoked a debate within the organization over the issue, recent events and interviews with union officials suggest.

The internal debate has serious implications for the organization, several of its leaders say, because any changes in the way teachers are rewarded would inevitably affect how instruction is delivered, how schools are organized, and what role teachers' unions play in such areas as collective bargaining.

NEWS ANALYSIS

"Talk of master teachers and differentiated staffing implies a good, hard look at the traditional single-teacher, single-class concept," said one official. "That's a pretty big bullet to bite, and some in the N.E.A. don't want to do it."

Futrell

Cameron

But other N.E.A. staff members, while describing themselves as "infuriated" over what they see as the President's "purely partisan" interest in education issues, also say Mr. Reagan's promotion of merit pay and his assault on the N.E.A. may be "a blessing in disguise." *(See related story on page 9.)*

It is causing the union, they say, to turn its attention back to professional issues after a number of years of focusing on broader national and international public-policy concerns under the leadership of Terry Herndon. Mr. Herndon resigned as executive director on June 1.

"There wasn't going to be much [education] reform under Herndon," one official said.

One indication that Mr. Reagan's merit-pay offensive caught the 1.6-million-member union off guard is the inconsistancy of its early public statements on the issue.

Shortly before Mr. Reagan's first reference to the issue in a commencement address at Seton Hall University on May 21, Mr. Herndon said the union would fight the master-teacher plan proposed by Gov. Lamar Alexander in Tennessee and similar plans introduced "anywhere" else. About two weeks later, his successor, Don Cameron, said the union was not opposed in principle to the idea of paying better teachers higher salaries, the central premise of the Tennessee plan.

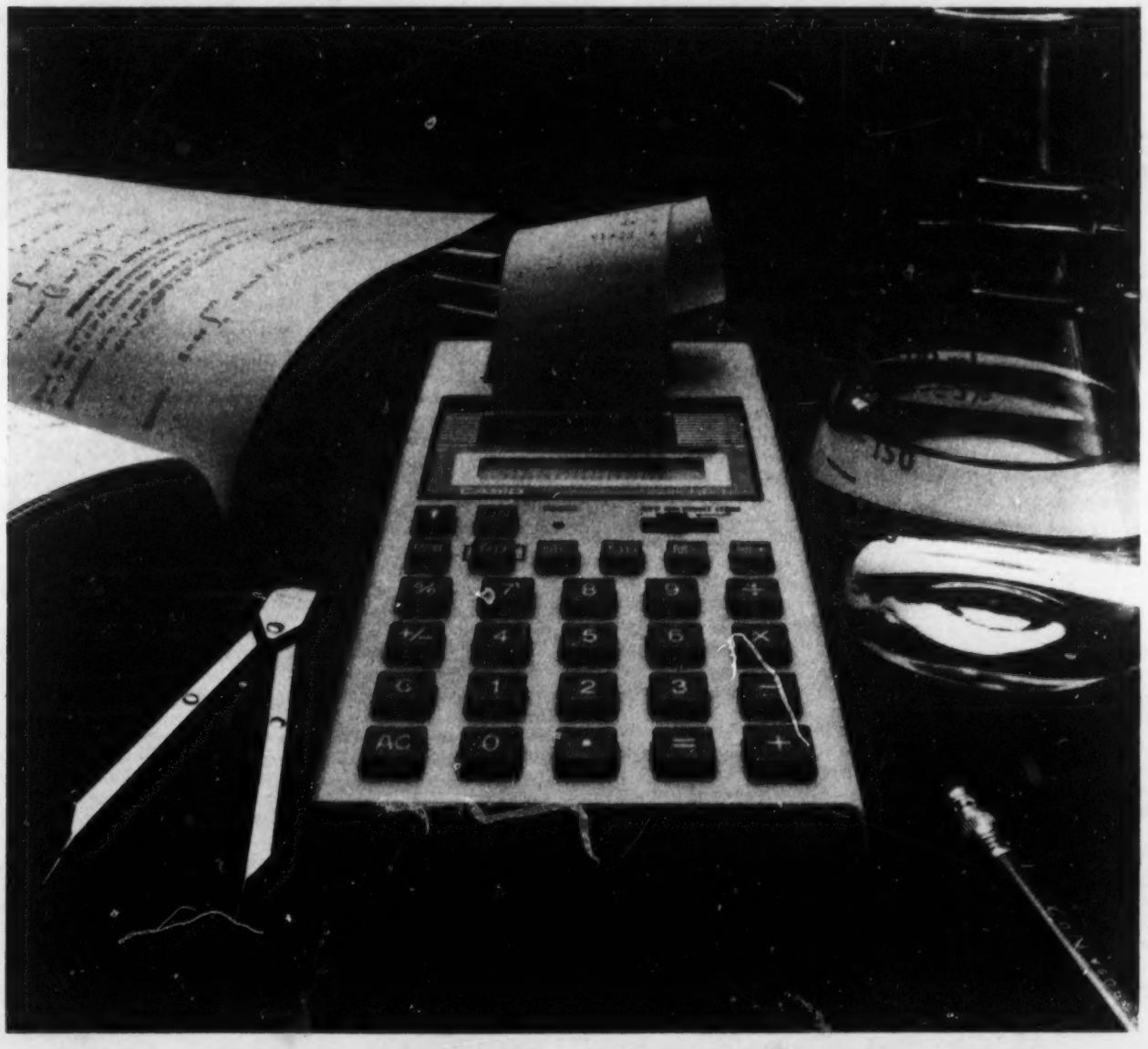
Simultaneously, the organization's president, Willard McGuire, was echoing Mr. Herndon's opposition to the idea of linking pay to performance in numerous newspa-

Continued on Page 13

AN EDUCATION WEEK SPECIAL REPORT

MATHEMATICS AND SCIENCE EDUCATION:

PROBLEMS AND PROSPECTS



INSIDE: The Problem 2 ■ Losing the Students 4 ■ Bridging the Gender Gap 4 ■ International Comparisons 7 ■ Viewpoints on the Problem 8 ■ A Profile of Teachers 10 ■ A Shortage of Teachers 11 ■ Retraining and Renewing Teachers 12 ■ Viewpoints on Teaching 14 ■ The Evolving Science Curriculum 16 ■ The Mathematics Curriculum 18 ■ The Role of Computers 19 ■ Training the Workforce 20 ■ Viewpoints on Curriculum 21 ■ Private Schools 22 ■ Colleges 24 ■ A Survey of State Initiatives 25 ■ Federal Initiatives 38 ■ Formulating Policy 38 ■ Viewpoints on Policymaking 41 ■ Studies 43 ■ Models 45 ■ Readings 52 ■ Viewpoints on Progress 64

THE PROBLEM

'White-Knuckling It' Up Through the

Researchers Explore How Eager Children Become Science-Math 'Dropouts'

By Peggy Caldwell

Nearly half of the adolescent students surveyed by the National Assessment of Educational Progress say they often read science articles in magazines and newspapers, watch science-related television programs, or do science projects that are not required for school.

Yet between 1969 and 1981, the percentage of high-school students taking most elective upper-level science courses declined perceptibly.

Nearly half of the nine-year-olds sampled by the national assessment listed mathematics as their favorite subject.

Yet, among high-school students, mathematics is considerably lower in popularity; both voluntary enrollment and achievement in the subject have declined.

Minority-group students, surveys indicate, have very positive attitudes toward science. Yet, with the exception of Asian Americans and Pacific Islanders, they are greatly underrepresented in upper-level mathematics and science courses and the careers to which those courses lead.

In the elementary grades, girls perform better than boys on many mathematical tasks. Yet despite their generally superior reading ability, girls tend to do worse on "word problems." By high school, both their attitudes and their performance are worse than those of boys—and by college, the differences are dramatic.

Researchers and practitioners have become increasingly concerned with what they call "math and science dropouts," and are exploring when and why such turnabouts occur.

From experience and field work, many researchers and educators have concluded that, all too often, students come to view mathematics and science as abstract, difficult, boring, and of questionable social value. Schools, they say, often employ methods and materials that discourage low achievers, girls, and minority-group students. In addition, colleges and, consequently, elementary and secondary schools have contributed to the decline by downplaying the importance of rigorous academic courses.

Young children like mathematics "because it's cut and dried; there is a right answer, and there's a lot of satisfaction in that," observes Victoria L. Chapman, editorial director of mathematics magazines for Scholastic Inc.

But, more than other subjects, mathematics and science become increasingly abstract and require orderly thinking and independence. "I think it follows this whole pattern of less self-discipline," says Marjorie Steinkamp, a science-education researcher at the University of Illinois. "When it comes to math and science, self-discipline is essential, and I think kids know that. Many young people are turned off to the 18- and 20- hour days that they see scientists as putting in."

The high-school curriculum itself may be another turn-off: "In 9th-grade algebra, you encountered these equations and binomials, and you could see no reason as to what it was all about," notes Lola J. May, elementary mathematics consultant for the public schools in Winnetka, Ill. "You had to keep all the numbers and letters straight, and there were these exponents flying around. For people who couldn't grasp abstractions easily, a chapter a week was just impossible. You were white-knuckling it."

MEANINGS VS. 'BASICS'

One of the ironies, educators say, is that application of mathematical and scientific principles—the very thing that makes the subjects more exciting and palatable—is one of American students' greatest weaknesses.

"The classic complaint is that kids know *how* to compute, but they don't know *when*," says Ms. Chapman of Scholastic Inc.

Ms. Chapman and others trace the problem to about 4th grade, when most schools expect students to consolidate and begin applying the reading and arithmetic skills they have learned so far. But the "back-to-basics" movement, with its emphasis on measurable skills such as decoding words—sometimes at the expense of understanding entire passages—has left many students poorly prepared for applied arithmetic and science.

Elizabeth Fennema, a well-known researcher in mathematics education at the University of Wisconsin, alludes to the "density" of word problems—"every word has an important meaning"—and suggests that even children who perform well in their reading classes may not have the powers of concentration and inference required to understand them.

"I think it's a thinking problem," Ms. Chapman says. "When you and I read, we are reading as literate people, making judgments as we go. Many youngsters, when they read, just call out the words and they read without thought. Similarly, with arithmetic, they rotely, routinely do the problem if it's set up for them.

"But the whole notion of wrinkling the brow and ferreting out meaning is a foreign notion to these kids. The idea that you read and figure out, that you read and pull out information, is foreign to them. I don't know why it happens this way. I do know that time and again you can walk into a classroom and find kids doing without thinking. American kids just are not doing a lot of thinking, ferreting out, studying, working at material."

For students now in high school, who attended elementary school before the "back-to-basics" thrust, the problem is slightly different, says Ms. May. "A lot of them went to 'open-classroom' elementary schools with individualized instruction. That produced a lot of children who didn't really know how to settle down and work when they really had to. We're now looking more at certain fundamentals, saying that these are things you have to learn."

TURNING AWAY FROM SPUTNIK

In what many observers believe was an overreaction to the post-Sputnik era—or a belief that the reforms of that period would solve the problems permanently—schools and society at large throughout the late 1960's and much of the 1970's placed a lower premium on scientific and mathematical attainment.

According to the National Center for Education Statistics, the national mean graduation requirement in mathematics is 1.7 years of high-school study, in science, 1.6 years. Available figures indicate that many students do the minimum. In 1980, according to "Public and Private Schools," the study by James S. Coleman and colleagues based on data from *High School and Beyond*, public-school seniors on average completed 2 years of mathematics and 1.7 years of science, private-school seniors about 2.4 years of mathematics and 2 years of science.

"In the last 10 years, no one has said, 'Hey, this is important,' " says Ms. Chapman. "Then the climate was, go to basics—computation and survival math, if you will. Now people are interested not so much in competency but in achievement, high

A 'Damning Set of Data': Subtle

Making mathematics and science seem useful may be a particularly important factor in addressing the underrepresentation and relatively lower achievement of female and minority-group students, some researchers believe.

In general, girls score lower than boys, and most minority groups score lower than whites, on "higher-level" problems that require students to figure out how to manipulate data, rather than to simply perform a computation or memorize a formula.

When the results are adjusted to account for the greater number of courses boys take, some researchers say, the gender-based differences in achievement become minuscule. But they remain concerned that the achievement gap and the different experiences they have in school will inhibit girls' and minorities' ability to compete in a technology-based economy.

And while some researchers are examining possible physiological causes, such as brain organization and spatial perception, others contend that physiological factors are either minor or irrelevant; they are focusing instead on what schools can do to counteract societal pressures that contribute to differences based on race and gender.

"We're trying to find out just what it is that attracts students," says Cora B. Marrett, a University of Wisconsin sociologist who is studying achievement and attitudes among minority-group girls. "One of the things that is taking place is precisely the absence of role models. Students may have done well enough in the courses, but it never occurs to them to make it a career.

"Beyond that," she adds, "it's important that they have a sense that the people in those fields are making social contributions and [that] teachers make clear the uses of mathematics or science. The greater sense the students get that these are fields that are meaningful and not just a career, the more likely they are to go on with it."

Ms. Marrett recalled one college student, an exceptionally gifted mathematician, who chose to go into economics because, as he explained it, "economics has some meaning and mathematics is so abstract."

"He didn't like the idea of sheer competitiveness, didn't like the idea of doing the work just for the sake of doing the work," Ms. Marrett says. "I think that's very common, particularly with minority students."

DIFFERENTIAL TREATMENT

A growing body of research suggests that teachers and other school personnel treat girls and minority students differently from white male students with regard to science and mathematics.

For example, Jane Butler Kahle, professor of biological sciences and education at

System

achievement. There's recently been more and more attention to telling kids that if you want to do this career, you need four years of high-school math. Now that the wheel has turned, they're going to get it. They'll be in a climate that says it's important. You get what you ask for."

A recent study by Clifford Adelman of the National Institute of Education indicates not only that enrollments in most science and mathematics courses declined, but that what was taught was often diluted and devalued.

Compounding the problem is what Mr. Adelman called "the rise of the general track," which he described as a disjointed collection of survey and personal-service courses. The general track, which accounted for only 12 percent of the students in his sample of 1969 high-school graduates, enrolled 42.5 percent of the students studied

Continued on next page

Differential Treatment of Girls and Blacks

Purdue University, has found that, as groups, girls and black students have less experience with actually performing experiments, taking field trips, and using equipment than do white males, even when they take the same courses. "It's a real damning set of data," she says, "and consequently, they score lower."

Elizabeth Fennema and others have found that, even in elementary school, teachers tend to interact more with boys than with girls in mathematics classes. Boys with "high confidence levels" tend to be called on most to give answers in class, she says, and girls with the highest confidence levels receive the least attention from teachers. The behavior and achievement vary from classroom to classroom and from school to school, she cautioned, but the same patterns show up in many schools.

Furthermore, Ms. Fennema notes, educators tend to tolerate girls who are not doing well in mathematics. "Schools get terribly concerned when boys don't do well in reading; they send them to remedial classes and make a great effort to help them. I would like to see the same kind of intensive effort in math. Quite often, girls with problems are not referred to remedial classes because the girls are not behavior problems."

Girls' attitudes toward mathematics and science appear to turn for the worse in middle or junior high school—about the time that they begin taking an interest in boys and do not want to compete with them. (Ms. Fennema's research indicates that boys are much more likely to view mathematics as a "male domain" than are girls.)

Other "affective" factors such as autonomy and "fate control"—students' sense that they can determine the course of their lives—have been used to help explain the high attrition rate of girls and minority students from math and science courses.

Ms. Fennema, noting that the two subjects require independent work, theorizes that teachers and parents, with the best of intentions, tend to help young girls to the extent that "they do not develop the kind of independence that they need to do math."

She has also found that girls are much more likely than boys to attribute their successes in mathematics to outside factors such as luck and good teachers. Boys tend to attribute their successes to ability and hard work, their failures to bad luck. This pattern, she contends, heavily influences the decision of many girls to drop out of mathematics and science.

Ms. Kahle has found similar patterns with black students in urban school systems, who also tend to attribute success to luck. "The notion of fate control is lower in minority students," she says. "That's why it's real important that they get a chance to work with equipment. Give them the equipment, and they see that the experiment comes out the same each time. If they can see that they can control that, they can maybe control other things."

She adds, however, that the minority students she has studied "have very, very positive attitudes about science. They're positive they can do science. At least you've got that attitude to build on."

THE SELF-CONFIDENCE FACTOR

Children who are behind in mathematics are often intimidated by some common games and techniques, Ms. Chapman says, and their self-confidence is further eroded. "College math professors say kids love puzzles. Well, the kinds of kids that those math professors used to be *do* love puzzles. For kids with weaker skills, a puzzle is another opportunity to fail. It's another chance not to get it. To kids who have poor skills, 'noodling' with numbers is a mystery, and puzzles are just agony," asserts Ms. Chapman.

Ms. Kahle and Penelope L. Peterson, a University of Wisconsin educational psychologist who is working with Ms. Fennema, suggest that seemingly minor alterations in teaching techniques and materials can help girls and minority students "feel more a part of the class."

Ms. Peterson, for example, says that girls seem to be more comfortable with word problems in mathematics if some of the problems concern topics that are traditionally in the female domain, such as recipes.

Similarly, according to Ms. Kahle, there is no reason a sewing machine cannot be used to demonstrate some mechanical concepts. "There has to be a conscientious effort to involve girls," she says. "They can't be allowed to pair with boys [in biology laboratories] and let the boys handle the frog."

For urban minority youngsters, Ms. Kahle adds, a highly structured classroom with as few interruptions and as many "hands-on" experiences as possible has been shown to produce achievement gains.

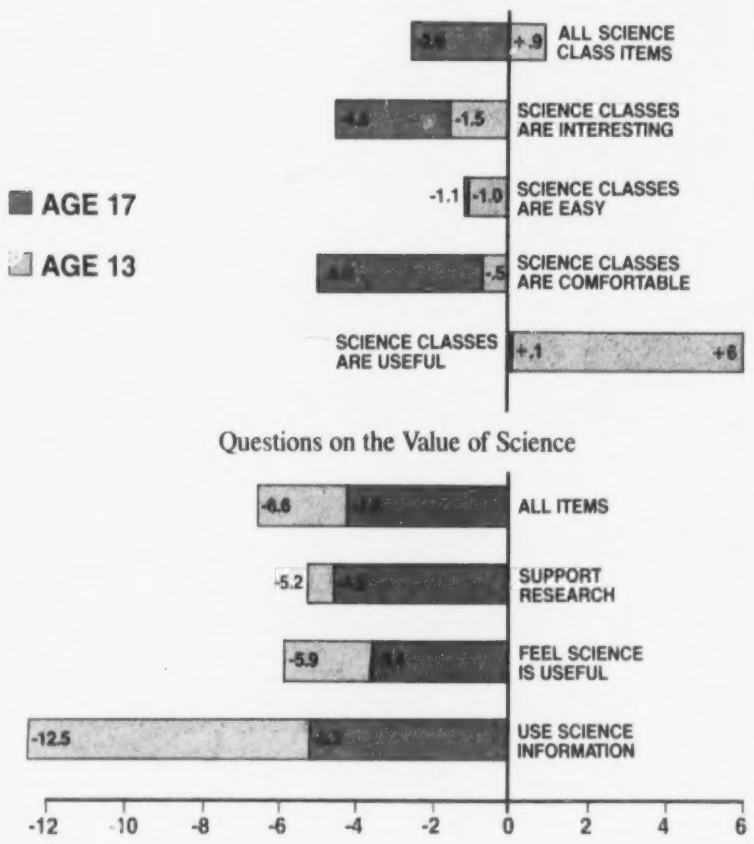
Ms. Fennema is convinced that relatively modest interventions can change the attitudes that often inhibit girls from pursuing math. She developed a series of videotapes, for example, aimed at students, teachers, counselors, and parents, that stressed the importance of mathematics and attempted to show that it is not an "unfeminine" discipline. In the high schools where the series was piloted, attitudes changed measurably and female enrollments in upper-level mathematics courses increased.

But she believes that, in most schools, pressure on girls not to pursue mathematics and science remains pervasive. "There are some cosmetic changes. We no longer have sexist books in schools, and I seldom hear an overtly sexist comment. But when I look at the behavior that I think is truly significant, it's not changing. I think teachers really are concerned, but the discrimination that goes on is so subtle that they don't recognize it."

—P.C.

THE PROBLEM

Changes in Attitudes of 13- and 17-Year-Olds Toward Science, 1977 to 1982



Source: *Images of Science*, 1982 National Assessment of Science

Continued from previous page

in the graduating classes of 1976 to 1981. During the same period, the percentage of students enrolled in the "academic/college preparatory" track fell from 48.8 to 36.4.

According to Mr. Adelman's transcript analysis, which was prepared for the National Commission on Excellence in Education, students in the "general track" were far less likely than academic-track students to have taken algebra and geometry, and more likely to have taken Consumer Math and such courses as Math 1 and Math 2, which Mr. Adelman characterized as frequently being general or remedial. Yet a high proportion of general-track graduates expected to attend college and to succeed.

Devaluation was also manifested in grade inflation, according to the Adelman study. While the proportion of students taking upper-level mathematics and science courses declined—as did scores on the Scholastic Aptitude Test and other standardized examinations—the percentage receiving A's and B's increased markedly, he noted. "Grades in mathematics and science courses rose at a faster rate than those in any other major course groupings," Mr. Adelman wrote. He offered three possible explanations: that only the most able students continue in mathematics and science; that teachers hike grades in an effort "to hold onto students"; and that teachers "perceive each course in the sequence as more of a college-preparatory course, hence hand out higher grades."

Whatever the reason, Mr. Adelman suggests, the grade inflation led students to believe they were learning more—while test results indicated they were not.

The Adelman study notes that a majority of colleges and universities eased entrance and graduation requirements during the intervening years. Other experts also believe there was a direct link between college requirements and high-school electives, and that higher college standards will help turn the situation around.

BEGINNING THE UPWARD CLIMB

There are already signs that students and their parents are responding to the well-publicized alarm over mathematics and science. Several states and districts report that enrollments in upper-level courses have begun to turn upward again in the past few years.

A nationwide survey of some 700 principals, analyzed by Wayne W. Welch, professor of educational psychology at the University of Minnesota, shows that 1981-82 enrollment rates in high-school biology, chemistry, and physics had risen by 2 to 6 percentage points since the 1976-77 school year. In grades 7 through 9, Mr. Welch found, the proportion of students enrolled in a science course held steady at 86 percent.

"I was kind of surprised at this," says Mr. Welch, whose special science project was supported by the National Science Foundation, with data collected by the National Assessment of Educational Progress. "I think we reached the nadir in the late 1970's. It's a slight upswing in the right direction."

Increases in statewide graduation requirements, he adds, have been too recent to account entirely for the upturn. "It probably reflects a return on the part of students to a more traditional attitude toward enrolling in subjects," he suggests. "You talk to principals now, and they say, 'Yeah, kids *are* more serious about schooling.' "

Adds David L. Dye, mathematics specialist for the Minnesota education department: "I think the publicity has resulted in parents' realizing that kids need to take those courses. Now, not everybody can understand calculus or precalculus concepts by 12th grade, but we don't know where that cutoff point is. We don't think we have reached it."

Perhaps the greatest challenge, according to some educators, is finding ways to harness and maintain the interest demonstrated by young children, without sacrificing rigor. For example, one educator noted that children quite rightly wonder why they spend weeks practicing three-digit multiplication when they can observe their parents using calculators. And surveys indicate that, while high-school freshmen regard mathematics as the subject that will be most useful to them in their adult lives, the perceived utility of both mathematics and science slips as students progress through high school.

"One of the big criticisms is that kids are turning off science and enrollment is dropping and their expertise is dropping," says Irma S. Jarcho, head of the science department at New York's New Lincoln School. "The reason, I think, is that teachers teach too much to the textbook and are so anxious to finish it that they can't be bothered with anything that's happening in the kids' lives."

The "irrelevance" problem, too, may stem from the recent emphasis on test scores and quantifiable skills. "Teachers have this great big conflict," says Ms. Chapman. "If, on April 4, my kids are going to be given the Iowa Test or whatever, I as a teacher have a duty to teach percentage increases and ratios. I'd want my kids to do well on the test. We never say to teachers, 'Take a week and give your kids this experience with numbers and data, pulling value from it as we do in the adult world, whether it's on a science level or a marketing level or a newspaper reporter's level. We are not asking teachers to act this way."

Comparison of Enrollments and Grades in Selected Mathematics and Science Courses, by Track

Graduating Classes of 1969 and 1976-81, Academic, General, and Vocational Tracks

Mathematics Courses

(A = Academic Track, G = General Track, V = Vocational Track)

	Percentage of Total Credits Generated						Percentage of Students Taking Course						Mean Grade-Point Average in Course, on a Scale of 4.0					
	Sample I (1969)			Sample II (1976-81)			I			II			I			II		
	A	G	V	A	G	V	A	G	V	A	G	V	A	G	V	A	G	V
Algebra I	4.6	3.7	3.3	3.8	3.2	3.0	86	68	66	72	60	55	2.43	1.65	1.85	2.45	2.11	2.03
Geometry I	3.2	0.9	1.1	3.3	1.4	0.9	78	22	24	72	32	21	2.31	1.55	1.96	2.55	2.12	2.15
Algebra II	2.3	0.8	0.8	2.6	0.9	0.6	52	18	17	56	19	13	2.23	1.63	1.91	2.58	2.31	1.98
Advanced Math	1.2	0.2	0.1	0.6	0.1	0.1	21	7	2	16	3	2	2.70	2.06	2.14	2.71	2.21	1.58
Math 1**	0.7	2.8	2.3	1.0	2.2	2.2	16	51	46	21	43	46	2.27	1.82	2.05	2.26	2.06	2.21
Math 2	0.2	0.6	0.4	0.3	0.6	0.7	4	12	8	11	14	14	2.13	1.75	1.87	2.21	1.93	2.17
Math 3	0.1	0.0	0.0	0.3	0.3	0.2	2	0	0	11	6	4	2.16	N.C.*	N.C.*	2.70	2.25	2.45
Math 4	0.2	0.2	0.1	0.3	0.1	0.1	4	7	3	8	3	2	2.61	1.76	2.11	2.70	2.98	2.83
Trigonometry	0.3	0.0	0.1	0.5	0.1	—	8	1	3	15	3	1	2.20	2.00	2.38	2.65	2.38	1.63
Geometry II	0.3	0.1	0.1	0.1	0.1	0.1	5	2	4	4	1	2	2.95	2.23	2.56	2.93	2.23	3.06
Business Math	0.1	0.5	1.2	0.2	0.9	0.9	3	11	24	6	21	20	2.01	1.62	1.96	2.28	2.03	2.17
Calculus	0.0	—	—	0.3	0.0	—	1	—	—	6	Nil	—	3.19	—	—	2.94	3.00	—
Applied Math	0.0	0.2	0.5	0.1	0.2	0.2	1	5	9	2	5	5	2.30	1.80	1.81	2.42	1.99	2.07
Arithmetic	0.0	0.0	0.0	—	0.1	0.1	1	1	1	—	2	2	2.22	1.20	1.71	—	2.02	2.51
Computer Science	—	—	—	0.2	0.1	0.0	—	—	—	6	2	2	—	—	—	2.92	2.34	1.72
Total	**14.0**	**10.2**	**10.4**	**13.4**	**10.4**	**9.2**	—	—	—	—	—	—	—	—	—	—	—	—

Science Courses

Biology 1	3.8	4.3	3.9	4.1	3.5	3.2	82	87	81	86	73	68	2.63	1.64	1.88	2.65	2.11	2.09
General Science	2.6	3.4	3.6	1.5	2.1	1.8	54	60	65	32	42	38	2.57	1.74	1.86	2.73	2.21	2.23
Physics 1*	1.1	0.1	0.2	2.2	1.2	1.2	23	2	4	43	24	25	2.65	2.17	1.76	2.70	2.11	2.19
Physical Science*	0.3	0.6	0.5	—	—	—*	7	11	10	—	—	—*	3.54	1.96	2.11	—	—	—*
Chemistry 1	2.7	0.5	0.6	2.8	0.9	0.3	57	10	12	61	19	8	2.31	1.88	2.14	2.63	2.20	1.86
Biology 2+	1.2	0.4	0.1	1.1	0.6	0.5	22	8	3	24	14	11	2.65	1.95	2.00	2.85	2.20	2.17
Geology	0.3	0.4	0.2	0.7	0.6	0.6	6	8	5	16	14	13	2.62	2.25	2.21	2.75	2.21	2.01
Chemistry 2+	0.4	0.2	0.0	0.4	0.0	0.0	8	3	1	8	1	0	2.53	2.36	2.64	2.75	2.87	2.00
Environmental Science	0.0	0.1	0.0	0.2	0.3	0.2	0	0	0	6	8	6	—	100	—	2.88	1.89	2.47
Advanced Physics	0.2	0.1	0.0	0.2	0.0	0.0	4	1	1	4	1	1	2.52	1.88	1.90	2.41	2.40	1.74
Total	**12.6**	**10.1**	**9.1**	**13.2**	**9.2**	**7.8**	—	—	—	—	—	—	—	—	—	—	—	—

N.C.–No Credit

*The course labels are not comparable for the two sets of transcripts studied. The data for Sample I (graduating class of 1969) distinguished between Physics I and Physical Science, a type of general science course that is offered principally in the 9th and 10th grades. The data for Sample II (classes of 1976–1981) did not make such a distinction, but folded both courses into the category of Physics I.

**The content of courses named Math I, II, III, and IV varies widely. In many schools, the labels are used for remedial courses.

Source: "*Devaluation, Diffusion, and the College Connection: A Study of High School Transcripts, 1964-1981*," Clifford Adelman, National Institute of Education.

BEST AVAILABLE COPY

BEST AVAILABLE COPY

200,000 Reasons for Concern: A Profile of Those Who Teach Sciences

By Thomas Toch

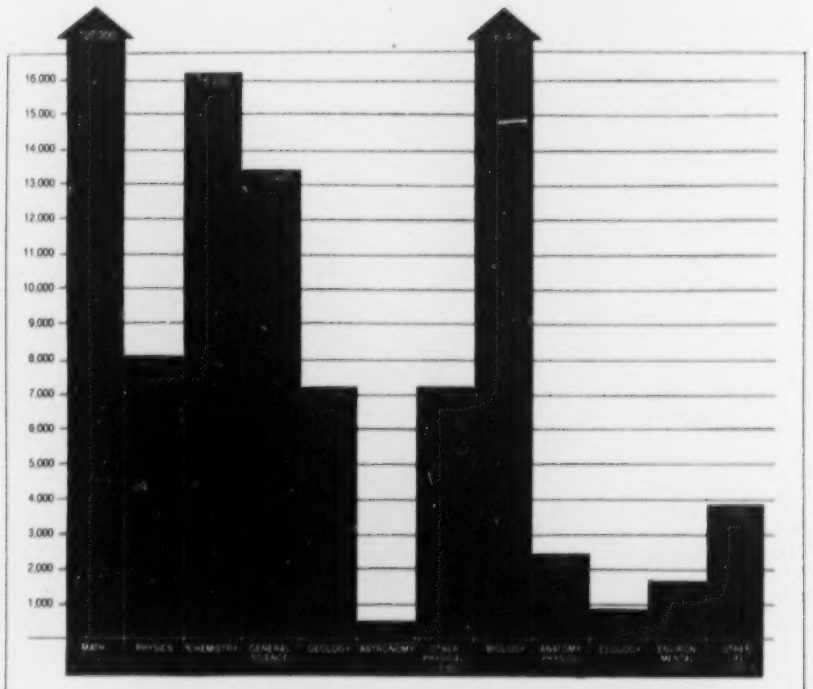
When Howard Harris talks about his salary, he alludes in exasperation and embarrassment to some of his students, who earn a higher hourly wage in part-time jobs at nearby Disney World. He holds a master's degree in chemistry and heads the science department at Oviedo High School in Seminole County, Fla., where he has taught for seven years. He earns $18,000 a year.

Other, less obvious, things bother him, too. When he teaches anatomy, instead of two students, five and six must share specimens, because his budget doesn't allow him to buy all of the shark and cat carcasses he needs. "A lot of kids miss things," he says. And he cannot perform many advanced experiments, because there is no money for sophisticated microscopes.

This past school year, Mr. Harris taught approximately 100 students. Because the Florida legislature recently tripled from one to three the number of science courses needed for high-school graduation, he will teach 150 students in the fall. In all, the 1,630-student school will offer 34 sections of science when it opens in September. But the annual science supply budget, $6,000, will be unchanged from this year.

Mr. Harris's principal recently asked him why he stays in teaching.

The question is relevant, because for every Howard Harris, there are many able mathematics and science teachers who will not tolerate the frustrations of teaching today. In a steady migration, many of the best in those fields have left the profession, usually for more lucrative jobs elsewhere. And the schools have not been able to attract enough able candidates to replace them.



Number of Teachers, By Field, 1982-83

Source: National Science Teachers Association

THE CERTIFICATION MORASS

Though there are outstanding mathematics and science teachers in the nation's classrooms, the profile of the typical public-school teacher of those subjects is not an encouraging one, people studying the situation say. Nor is it appreciably better in many private schools.

According to figures from the National Science Teachers Association (N.S.T.A.), the equivalent of about 107,300 full-time math teachers and 92,100 full-time science teachers taught in public and private schools during the 1982-83 school year (the figures combine part-time slots). Thousands of those teachers—60,000, says the N.S.T.A.—had little or no training in the subjects.

"We are in the awkward position of having to have people in physics who don't have a very good understanding of what they are doing," says Jack M. Wilson, executive officer of the American Association of Physics Teachers. One reason is that state standards for math and science teachers are in some cases very low, according to several studies.

In 14 states, including Texas, which alone employs 7.5 percent of the nation's public-school teachers, school systems are allowed to assign any teacher to teach math and science, no matter how little training a teacher happens to have in those subjects.

And, faced with a rapidly shrinking supply of math and science teachers, schools are taking advantage of this option. Nearly 40 percent of those teachers who taught one or more math classes in grades 7 through 12 in North Carolina during the 1980-81 school year did not have a math certificate, according to a study by the North Carolina Center for Public Policy Research. Earlier this summer, North Carolina changed its policy. In the future, teachers must be certified or working towards a certificate in the subjects they teach.

At least half of the states allow a teacher with a certificate in one science subject to teach any other science subject, regardless of the teacher's lack of training in the other subjects. "There are teachers teaching three or four, sometimes five, different subjects a day, subjects they've had virtually no training in," says Trevor G. Howe, professor of education and director of education placement at Iowa State University at Ames.

Moreover, the number of semester hours of college training required to teach math and science speciality subjects at the secondary level starts in some states at as low as 12, writes Elizabeth H. Woellner of the University of Chicago in the 1983-84 edition of *Requirements for Certification*.

Elizabeth Useem of Northeastern University reported in a 1982 study that 50 percent of the "new" math certificates granted by Massachusetts in 1981 were awarded to veteran teachers of other subjects who had taken a few math courses and "added on" a certificate in math. Wrote Ms. Useem: "These 'add-ons' are not truly qualified to teach more than introductory courses."

In Georgia, teachers certified in some other subject can add a math "endorsement"—an additional area of certification—for one year by taking as few as 10 quarter-hours of college math. "School superintendents have often asked our department to design a few brief workshops to somehow turn these unprepared people into math teachers," James W. Wilson, professor of math education at the University of Georgia told a Council for Basic Education symposium in April.

"Certification is essentially meaningless," said Bill G. Aldridge, N.S.T.A.'s executive director.

DISAGREEMENTS ON TRAINING

There are other reasons for the apparent low quality of many math and science teachers.

Many states require little or no science coursework of an elementary-school teacher—and that which is required in schools of education is often offered in less-demanding courses such as "General Science for Elementary Teachers."

Moreover, in many states, an elementary-school certificate allows a teacher to teach up to the 8th grade. So junior-high students are frequently taught science courses by certified elementary-school teachers who have at best minimal training in science.

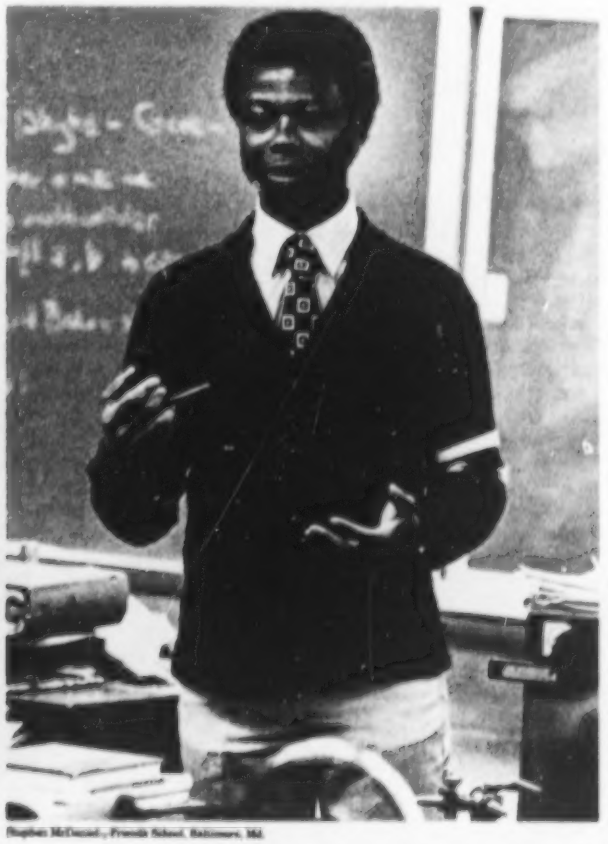
Many experts believe that science and math specialists—whose four-year undergraduate study usually includes 50 percent general education, 25 percent pedagogy, and 25 percent courses in the major—are now adequately trained. Others disagree.

"[Math teachers] may be equipped to use the textbooks they are given, but they are not equipped [by education schools] to develop curriculum units of their own. They know about the content of the courses in the grades they teach, but they are not familiar with—and may not consider it their business to know about—the math taught in other grades or in other school subjects. In short, they have not been educated to be math educators," Jeremy Kilpatrick and Mr. Wilson of Georgia wrote in a paper prepared for a February 1983 conference, sponsored by the National Institute of Education.

In general, math and science teachers who major in education receive between 30 and 35 semester hours of college instruction in those areas, 5 to 15 hours less than those who major in math and science.

Nor do many math and science teachers seem to keep up to date in their fields once they begin teaching. Based on a December 1982 survey, the N.S.T.A. estimates that only 16 percent of the physics and chemistry teachers who taught these subjects more than half time during the 1982-83 school year had upgraded their skills through workshops or college courses within the past three years. For math teachers, the figure was even lower, 5 percent. And 40 percent of those who responded to a similar survey in December 1981 said they had not attended a course or workshop since they began teaching, which was an average of 16 years earlier.

See PROFILE on page 58



Stephen McDaniel, Fredrick School, Baltimore, Md.

Science and mathematics teachers are hard to find, and critics say many of those teaching are inadequately trained. Teachers counter that their jobs are not easy. They endure budget cuts, large classes, obsolete equipment, distracted students, and lower wages than some youths earn in part-time jobs.

Teacher Shortage: Likely To Get Worse Before It Gets Better

By Hope Aldrich

The already severe shortage of science and mathematics teachers in most parts of the country is expected to grow steadily worse in the next 15 years, experts predict.

The number of new teachers graduating in these fields is expected to dwindle further each year. Last year, an average of only three mathematics teachers and five science teachers graduated from each teacher-training college, according to the National Science Teachers Association (N.S.T.A.).

And the "crisis" will be deepened by a gradual rise in the number of school-age children beginning in 1985, by increased graduation requirements in many states, and by an unusually high retirement rate among science and math teachers, the experts say.

There are now about 200,000 teachers of science and mathematics in the nation's classrooms, according to the National Center for Education Statistics (N.C.E.S.).

Most analysts agree that the nation's schools need about 60,000 additional science and math teachers to replace those who are unqualified or minimally qualified and have been hired on emergency waivers.

That need varies widely by region. In Pacific states, the percentage of unqualified teachers reached 84 percent in the 1981-82 school year; in Northeastern states it was at 9 percent, according to N.S.T.A. figures.

Between now and the mid-1990's, when the shortage is expected to reach its peak, the schools may need as many as 300,000 additional science and mathematics teachers, according to some educators.

"There is no way we will possibly meet the demand under the present incentive system," says John A. Nelson, dean of the education school at California State University at Long Beach, one of the largest in the country. He adds that high-technology companies in his area immediately siphon off many of his graduates.

Educators also suggest, however, that their pessimistic forecasts could be altered by such variables as increased incentives to enter teaching in these areas, an upturn in the economy, increases in college aid for prospective teachers, or changes in retirement policies.

In the near future, the trend to increase graduation requirements in science and mathematics may exacerbate the shortage. More than half the states have passed or are considering increased requirements at the high-school level. If schools raised their requirements by one year in each subject, 68,000 more teachers would be required nationally, Secretary of Education Terrel H. Bell said in a speech early this year.

In addition, by the 1990's, two significant demographic trends will converge to create a serious shortage, the experts project.

One of these is school enrollments. Increases will begin at the elementary level in about 1985 and will reach the middle- and secondary-school levels starting in about 1992, according to Valena Plisko, an N.C.E.S. editor and statistician. Total enrollment is expected to increase by about 2 percent, or about 400,000 children, annually for about 15 years, predicts Ms. Plisko.

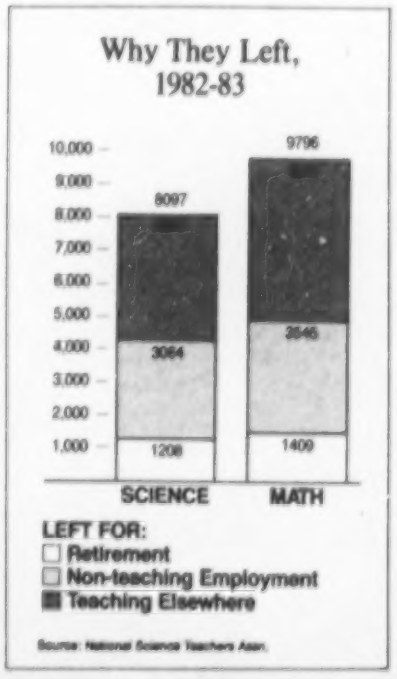
The enrollment increases are expected to exceed 2 percent per year in the Southeast, the Rocky Mountain states, the Southwest, the Plains, and the Northwest states—30-percent annual increases are forecast for Utah and Wyoming—according to the N.C.E.S. data. But enrollment in the Mideast states is expected to continue to decline, and in the Northeast and Great Lakes states, trends will be mixed.

About 200,000 new elementary-school teachers will be needed as early as 1990, according to N.C.E.S. projections, and that need will reach secondary schools by 1995.

A "retirement bulge" is the second factor expected to compound the shortage. The average age of the nation's science and mathematics teachers is 41, according to a survey by the science teachers' association. By 1995, at least 40 percent of the present 200,000 mathematics and science teachers will be retired, predicts the N.S.T.A.

"We'll be hit by a double-whammy—by the retirement bulge and the increase in enrollment," says Stanley Hecker, professor of administration at Michigan State University's college of education.

The enrollment increase will not reach the college level until about 1997, says Ms. Plisko of N.C.E.S. At that point, it may increase the number of college students who choose teaching careers.



Source: National Science Teachers Assn.

The combination of demographic change and increased requirements could mean at least 300,000 new teachers would be needed in mathematics and science by 1995, according to N.S.T.A. officials. These teachers could be recruited from outside the profession or retrained from within, they said.

In an era of declining revenues, spokesmen for teacher-training institutions and school districts express pessimism about the financial implications of the shortage.

For example, Mr. Nelson of the California State University foresees years of financial losses ahead for institutions that continue to offer mathematics methodology courses. His school regularly runs methodology classes with enrollments of only six or seven students, although it takes 25 in a class to break even, he says.

At large schools like Long Beach—which last year graduated six mathematics teachers out of a total of 1,500 education graduates—such losses can be cushioned by overenrolling other classes, Mr. Nelson says, but few smaller colleges can afford special classes for a handful of students, he warns.

In the nearby Los Angeles Unified School District, Rosalyn Heyman, assistant superintendent for secondary education, is also concerned about costs. She points out that proposed new graduation standards in mathematics and science would require the addition of 283 new teachers in her district and would cost about $6 million, including salaries, fringe benefits, and supplies.

Such costs, says Ms. Heyman, are "unthinkable"; if the new requirements go into effect, the district will meet the need by retraining teachers from other fields.

For many other districts, says Mr. Hecker of Michigan State, retraining older teachers is "the only hope."

To Democratize Science: Curricula for 'Citizens'

Would Emphasize Applications

Science should be taught to children early and often, specialists argue, if they are to develop the interest and knowledge essential for later learning. And the emphasis at all levels should be on applications and "hands-on" experience, they say.

By Susan Walton

When scientists and educators in the late 1950's set out to create new curricula for precollege students, the issue at the top of the agenda was increasing the supply of scientists and engineers. Teaching "pure science" to the brightest students was the order of the day, and the materials they developed are widely regarded as good vehicles for doing just that.

Today, science educators face the task that the earlier effort left unfinished—figuring out how best to teach science to *all* students, especially those who may not become scientists, but whose lives and work will be touched by developments in science and technology. Ensuring an adequate supply of scientists will always be important, many science educators agree, but the more urgent need lies in broadening the teaching of science to reach more students.

"I think it goes back to the proven record," says Jane Butler Kahle, professor of biological sciences and education at Purdue University. "We've done a good job in educating future scientists and engineers, but what's happened is that we've simply lost the general citizen."

The two issues, science educators point out, are not entirely separate. By improving the teaching of science at all levels, they say, schools would probably expand the pool of future scientists as well, since students would be less likely to opt out of science at an early age.

The science curriculum—how many courses and what kinds—is at the center of the debate. Some of the recommendations, and disagreements, emerging include:

- Science should occupy more time at the elementary-school level. Most students are taught some—but not enough—science.
- The requirements for science in high school and junior high should be increased. Until recently, when many states began stiffening their requirements, many high-school students took only one or two years of science. New state standards will change that situation. However, many science educators regard the current approach and sequence of science courses as inappropriate for many students, and they argue that simply requiring more of the same will not solve the problem.
- Science courses should be more carefully matched to students' levels of intellectual development, as these levels have been characterized by researchers such as Jean Piaget, the Swiss psychologist. Research has shown that in many cases, the material that students are expected to learn is far too abstract for them to understand; unless it can be presented in more concrete form, they will memorize facts without understanding the concepts.
- Applications of science—including technology—should be incorporated into the science courses. The post-Sputnik curricula eliminated both on the grounds that they were not "pure" science, but now many science educators argue that science courses should focus heavily on applications. Similarly, technology has become a far more powerful force in the world and is in many cases an integral part of the process of "doing science." Whether the two should be linked in the curriculum is being debated.
- The effect of science on society has become an important topic, and some science educators argue that the science classroom is the proper place to discuss it. But since many related issues move beyond science into the realm of values, others argue that science education should not assume that additional responsibility.

TEACHING SCIENCE EARLY

The process of improving students' understanding of science must begin early and continue throughout their school years, science educators agree. Unless children are exposed to science early and often, most will develop neither the interest nor the foundation of knowledge they need to become scientifically literate.

The best way to teach science to elementary students, these educators suggest, is to use many concrete activities and examples, capitalizing on children's natural curiosity about how things work.

"I feel strongly that science should begin as soon as children enter school, and children should receive some science every day," says Alice Moses, president elect of the National Science Teachers Association (N.S.T.A.), who teaches science to kindergarten through 8th-grade students at the University of Chicago Laboratory Schools.

"You begin to establish attitudes in youngsters early on," Ms. Moses says, "to build attitudes of inquiry," that help them explore the world and build a base of knowledge about it. "It's also the beginning of laying the groundwork for the youngsters who might be inclined to go into the sciences."

And although most science educators agree that it is important to be alert for the child with a clear affinity and talent for science, many stress that identifying and working with those students should not be the primary goal of science education. "Is the purpose of the 3rd grade to find out who's going to get a Ph. D. in biochemistry?" says Robert Yager, professor of science education at the University of Iowa.

"Formal, systematic interaction with and observation of the real world are essential in elementary education. Elementary-school science should provide much of this experience," notes a report prepared by the Conference on Goals and Science for Science and Technology Education for the National Science Board's precollege commission. The conference brought together dozens of scientists and educators from all levels of education; the report recommends future directions for science education.

"A good elementary science program should be a planned set of experiences representing a balance among the disciplines, a daily lesson, and (frequently) hands-on experience," the report says.

In the elementary grades as well as later science provides an excellent vehicle for teaching students how to solve problems, the report notes. The "basic skills of science," which translate readily to other areas, include recognizing problems, developing procedures for addressing them, and recognizing, evaluating, and applying solutions. The report urges teachers to make use of the school campus, as well as museums and other resources in teaching children about natural phenomena.

"They should be almost entirely engaged in real, direct experience with phenomena: taste, touch, feel, see," says Bill G. Aldridge, executive director of the N.S.T.A. and a former teacher of physics. "Look through a telescope. Don't try to explain it. Look at the stars every morning for four or five months and draw pictures. Do safe chemical experiments. Observe. And do nothing else. Don't try to explain what protons, neutrons, and electrons are. Focus on observation and concrete experience."

Children miss something if a teacher does little more than "stand there and give a child a book and say, 'read this,' and [does] not have the child really experience the doing part," Ms. Moses says. "You could read a book but you couldn't get the same sensation" that comes with witnessing a phenomenon or performing an experiment.

Many of the textbooks and other materials designed for elementary students are designed to take advantage of the children's natural curiosity and interest in the world around them, science specialists say, but elementary-school teachers frequently do not take advantage of the materials available. On the average, teachers in the early grades spend about 20 minutes each day on science, according to various surveys.

"You get the youngsters, and they're so fresh, so interested," says Alice Moses. "It's such a wonderful time to capture the curiousity of young children. Unfortunately, often it isn't captured."

PRESSURES ON TEACHERS

Science educators attribute the absence of science in elementary schools to several factors. One is that it must compete with other subjects that are viewed as more important. Ms. Moses cites the "pressures put on teachers for basics" and also the "amenities" that parents expect elementary teachers to inculcate—good manners and the like. "I think with these kinds of pressures being brought to bear, sometimes science goes by the board," she says.

But another reason, regarded by many educators as the heart of the problem, is that many elementary-school teachers are not comfortable teaching science and avoid it whenever possible. In general, the teachers have only minimal training in science, according to several studies.

"The problem generally is that elementary teachers don't take any science and they don't teach any science as a consequence," Ms. Kahle says. "Science is the last subject in the five academic areas in terms of the number of minutes per day spent on it. There is good information that elementary teachers feel more insecure," and there is a correlation between insecurity and the amount of time spent on science, she says.

"I feel very strongly that there are some very good elementary curricula that teachers are afraid to use," Ms. Kahle adds.

"The texts are all right," says Mr. Aldridge of N.S.T.A.. "There are some pretty good materials. The problem is, nobody knows how to use them. The materials are probably the best. That's the irony."

Notes Ms. Moses: "The texts have improved tremendously on the elementary level. They are designed with a lot of things in mind. The reading levels are appropriate for most of the students and they are sequential. Attention is given to developing materials [that build on] previous grades. They are colorful, with excellent photography, and by and large are written well, with a lot of hands-on kinds of things that kids can do with the content materials."

But teachers may lack the time—and the inclination—to set up and organize hands-on activities, Ms. Kahle points out, adding: "If they can, they won't because they're pressed for time for math and reading."

Although science educators agree that it would be helpful if potential elementary-school teachers were more interested in science and took more science in college, few seem optimistic about the prospects. A more realistic approach, they say, would be for school districts to hire special science teachers who enjoy and understand science.

"I don't think we're going to turn it around with the teachers," says Ms. Kahle. "I would like to see us hire science specialists or science consultants. Until we do that, we're not going to get more science in the elementary schools."

Some districts do have a "science resource teacher" or supervisor, but budget cuts have forced many districts to abandon that position, Mr. Aldridge said. In recent years, he noted, 70 percent of the elementary science-supervisor positions have been cut.

LEVELS OF ABSTRACTION

The science that students learn in elementary school becomes the base for their future understanding of the subject, and also affects their attitude toward it—a key factor in keeping them in science classes. The secondary-school curriculum, science educators suggest, builds on that early experience by teaching the concepts students need whether or not they become scientists.

The topics taught are one key component of this process. Another, which has received less recognition, is whether the level of abstraction of the material fits with the students' intellectual development.

The secondary-school materials used now, which are largely derived from the post-Sputnik curricula, approach science in a very theoretical fashion. "The degree of abstraction is very substantial," says Mr. Aldridge. As he and others point out, the people who developed those materials chose to make them highly abstract on the grounds that such an approach more accurately reflected "pure science."

Subsequent research, however, suggests that this abstract approach probably prevents many students from fully understanding the material. The problem is largely confined to secondary-school students, since elementary-school teaching generally does focus on concrete materials.

In the mid-1970's, John W. Renner, a professor of physics and science education at the University of Oklahoma, began gathering data to see whether the materials used in secondary science courses matched the students' level of intellectual development. He and a colleague, Anton E. Lawson, a biologist at Purdue University, defined two categories of concepts used by Piaget, the "concrete operational" and the "formal operational."

The first includes concepts "whose meaning can be developed from first-hand experience with objects and events," according to a 1975 paper by the two researchers. The second, formal operational, includes concepts "whose meaning is derived through position within a postulatory-deductive system," that is, through theoretical models. "Meaning is given to these concepts not through the senses but through imagination or through their logical relationships within the system," the researchers write.

Students' levels of development, in turn, can be measured using a series of tests developed by Piaget and placed in a corresponding category.

According to Piaget's model, the authors write, children begin to make the transition from concrete to more abstract understanding around the age of 11. If that model is correct, they note, then most junior-high and high-school students could readily un-

See SCIENCE on page 54

COLLEGES

Problems at Both Ends Of the 'Pipeline'

Remedial Classes, Shrinking Ph.D. Pool

By Sheppard Ranbom

Colleges and universities pay a high price, their leaders say, for the failure of high schools to teach mathematics and science adequately.

Edward J. Bloustein, president of Rutgers University, says that some "20 to 30 percent of students" attending U.S. colleges and universities need remedial training in mathematics. Many "haven't taken the necessary courses in mathematics in high school," while others meet formal requirements but still "don't measure up" to expectations, he contends.

Statistics support his claim. A national survey of four-year institutions conducted in 1981 by the Conference Board of Mathematical Sciences found that enrollment in remedial mathematics at four-year colleges increased 72 percent between 1975 and 1980. In 1980, 25 percent of the mathematics courses taught at four-year public institutions were remedial; 42 percent were remedial at two-year colleges.

"I've seen college freshmen who don't know how to add one-half and one-third, and last year I met a student who didn't know the meaning of the word fraction," says Sandy Athanassiou, a learning-resource specialist who coordinates a remedial math program at the University of Missouri. A 1982 survey of incoming freshmen at the university indicated that 24 percent of the students anticipated needing remedial work in math.

Academic administrators may not be able to calculate the social costs of this problem, but they say they are painfully aware of the immediate financial toll. Ms. Athanassiou's remedial center, for example, costs $300,000 a year to operate. And according to the California Postsecondary Education Commission, the cost of running remedial programs in all subjects in the University of California system was $6.6 million in 1980-81; in the state-college system, the cost was $9.3 million; and in the community-college system, it was $66.3 million.

Last summer, the Louisiana Board of Regents for Higher Education estimated that the state's colleges and universities would spend about $13 million on remedial education in 1982-83, more than twice what they spent in 1979-80.

Leaders of both public and private institutions agree that they share the blame with high schools for the decline in mathematics and science achievement among today's students.

"Open-door" admissions policies, they acknowledge, took the pressure off students to work hard in high school. By being "lax in setting our own requirements, we failed in the same way" that parents, schools, business, government, and the society at large have, Mr. Bloustein acknowledges.

Recognizing that, many institutions are now spelling out for high-school students what specific courses they will need to take in all areas to be successful in college. And they are upgrading their entrance requirements, calling for more years of study in the so-called "academic core" subjects—in mathematics, science, and language arts.

Well over half the states have announced—or are in the process of formulating—more rigorous admissions standards for their public colleges and universities. Most of these new requirements include more years of study in mathematics and science.

"We are receiving into college a group less equipped to receive the culture we are designated to transmit," says Mr. Bloustein, who notes that unless the situation is changed students will live "less fruitful lives," have "mistaken notions about employment," and "diminish the nation's economic position in an increasingly sophisticated world market."

LINKS WITH SCHOOLS

Acknowledging a share of the blame for the problem as well as a clear financial interest in admitting students who are better prepared, a number of colleges are responding to the pressure in their local communities for solutions by working with local schools on a variety of educational-improvement projects.

Cooperative arrangements are being established that provide inservice training for teachers; use faculty expertise to develop school curricula; make university facilities available to students during the school year, including internships that give high-school students "hands on" experience in research labs; develop special summer programs for high-school students; help bring technology and computer-assisted instruction into the schools; and accelerate the work of gifted students.

The Carnegie Foundation for the Advancement of Teaching released a special report last winter that documented collaborative efforts nationwide. The report recommended that "every college and university establish a partnership with one or more school districts to provide educational and cultural enrichment as determined by principals and teachers at the schools."

The College Board has also been taking steps to improve the preparation of high-school students. In 1980, it launched Project EQuality, a 10-year program to develop a model set of "competencies" that high-school graduates should have, and a curriculum to achieve them. Project officials will also ask colleges to adopt these competencies as a preferred standard of preparation; study successful remedial programs in colleges and share the findings with high schools; enlist the help of business and labor to determine which of the academic skills are most relevant to the world of work; and encourage the creation of school-college pilot projects designed to improve academics in the schools.

In May, the College Board detailed the skills in six fields of study that every student aiming for college ought to master.

A LONG LIST OF PROBLEMS

But even as they attempt to address the problem at the precollegiate level, college and university leaders point out that they have serious math and science problems that are totally unrelated to the schools. Poorly trained undergraduates constitute only one on a long list of problems that have plagued academic programs in the sciences over the past 15 years, they say. Among them:

• **The 'Brain Drain.'** Faculty members in chemistry, engineering, electronics, and computer science have been leaving academe in growing numbers over the past few years for better-paying positions in business and industry and for better working conditions.

At the same time, the student demand for courses in computer science (the total number of earned bachelor's degrees boomed by 367 percent from 1971 to 1980) and engineering (in which bachelor's degrees increased by more than 50 percent between 1975 and 1980) has put tremendous pressure on colleges to come up with teachers and programs.

But the search for faculty becomes increasingly difficult, officials say, as industry's lure for trained scientists grows.

A survey conducted by the American Council on Education indicated that a total of nearly 1,600 (about 10 percent) of faculty positions in engineering were unfilled as of September 1980. Of these, 45 percent had been vacant since 1979.

The so-called "brain drain" is affecting not only research universities but the nation's community colleges as well. Robert McCabe, president of the nation's largest two-year institution, Miami-Dade Community College in Florida, speaks for many of his colleagues when he points out that his faculty members in data processing, computer science, electronics, and business are being hired away by corporate recruiters.

• **Eating the 'Seed Corn'.** Not only is the business world luring away existing faculty from academe, higher-education leaders point out, but it is also taking the best students in mathematics, engineering, and science. These are the talented young scholars who traditionally would have gone on for their Ph.D.'s and then replenished the faculty ranks. Businesses can, and do, offer "three times the salary" of a graduate assistantship to new recipients of baccalaureate degrees in sought-after science fields, according to Mr. Bloustein.

Declining federal support for graduate programs and facilities, student uncertainty over the availability of financial aid and fear of incurring large debts, and a current glut of professors in many academic disciplines have also led students away from academe, those who study higher-education trends say.

The result of the various forces propelling talent out of the academic world is a situation many university leaders have described as society "devouring its seed corn"—robbing colleges and universities of a generation of graduate students who are needed to produce the scientists and engineers of the future.

The average age of tenured faculty in mathematics, engineering, and the sciences is about 50, according to Robert Rosenzweig, president of the Association of American Universities. When these professors retire in 10 or 15 years, colleges and universities will be hard-pressed to find first-rate people to replace them, he says.

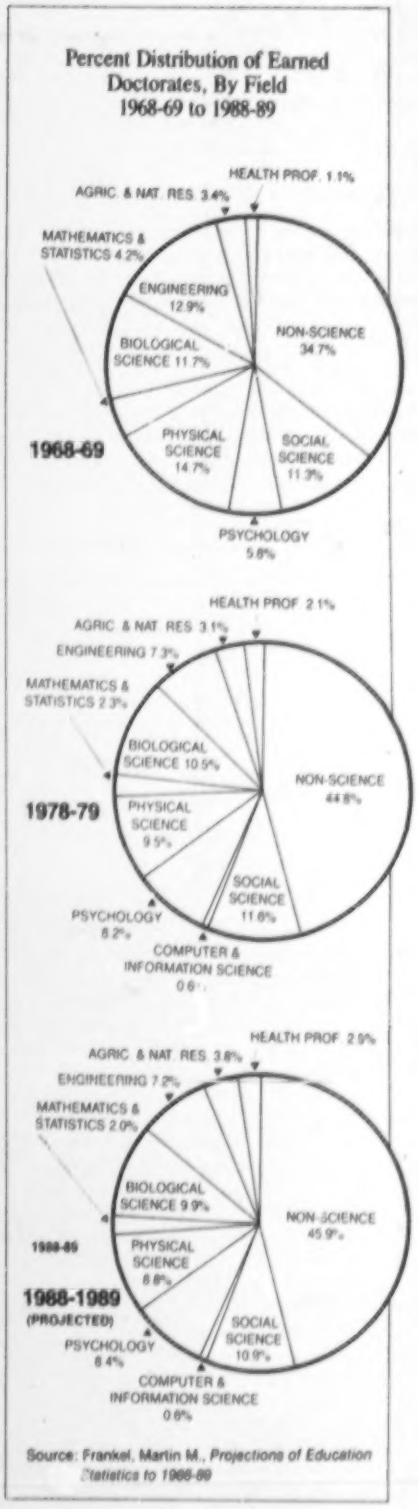
The number of students earning doctor's degrees in engineering declined by 31 percent during the period between 1971 and 1980, according to the National Center for Education Statistics (N.C.E.S.). Moreover, a growing number of engineering graduates (more than 50 percent) are foreign students, many of whom may return to their homelands, according to Mr. Rosenzweig.

Mr. Rosenzweig notes that the high percentage of foreigners, over time, creates "instability" in the faculty ranks. Given the importance of engineering technology to our society, he says, it is "clearly an unhealthy situation" to have the most highly trained segment of the technological workforce composed of other than U.S. citizens.

In the physical sciences, the number of master's degrees and doctor's degrees awarded dropped 18 and 30 percent, respectively, from 1971 to 1980, N.C.E.S. reported.

Bachelor's degrees in mathematics have dropped 54 percent, master's degrees 45 percent, and doctoral degrees 40 percent since 1971, according to N.C.E.S.

See COLLEGES on page 57



QUALITY EDUCATION Begins With QUALITY TEACHERS.

Suddenly, America has discovered quality education. And, it seems, dozens of pet formulas for achieving it: Putting more money into the schools. Putting computers into the schools. Putting more discipline into the schools. Putting more "basics" into the schools. Even putting prayer into the schools.

But quality education can't be achieved without quality teachers. And we won't continue to get them from "quick fix" solutions.

It will mean raising standards for accreditation of teachers' colleges and graduate schools.

States will have to toughen their teacher licensing standards and school districts must refuse to hire, even "temporarily", would-be teachers who do not meet those standards.

School administrators will have to take responsibility for the caliber of teachers they hire and retain.

And yes, schools and colleges will have to offer the kind of salaries that will attract our best and brightest young people to the teaching profession and will keep them from abandoning it.

The National Education Association has, since 1857, worked to promote the welfare of all students and to help all students realize their maximum potential.

Today, the 1.7-million member NEA asks all Americans to join us in this vital crusade to achieve real educational excellence.

nea **A Strong America Needs Strong Public Schools**

SCIENCE

Continued from page 17

derstand "formal" material.

But Mr. Renner and Mr. Lawson are quick to point out that recent research indicates that, to the contrary, "perhaps from 40 to 75 percent of the secondary-school students have failed to reach the level of formal thought."

"If the Piagetian model is correct in contending that concrete thinkers cannot develop understanding of abstract subject matter, and if, indeed, a large portion of secondary students are concrete operational, then a major portion of today's secondary-school science curricula which the foundation-sponsored projects have developed is beyond the students' level of understanding and, therefore, inappropriate," the researchers write.

"What we find, consistently, is that persons who can be labeled concrete operational do not have success on concepts that could be labeled formal operational," Mr. Renner said in an interview. "For example, kinetic molecular theory is a formal concept. Concrete operational kids can memorize it, but when it comes to using it to explain something else, they can't do it.

"It begins to look like the concepts you can rate as requiring formal thought are not available to students who have tested out as being concrete operational," he says.

"The curriculum is definitely out of step, out of phase, with the intellectual development of the kids," Mr. Renner adds.

He notes, for example, that "most of what's in high-school biology is highly formal, and that's 10th grade. When you measure the operational rating of 10th graders, 65 percent usually are concrete. When you take a class that's an average of 70 percent concrete and give them a class, 95 percent of which requires formal thought, you're in a heap of trouble. The kids simply can't learn. But it seems impossible to get that concept across to educators. They don't appreciate the 'cannot learn' thing."

Students who are confronted with material that is beyond their intellectual level, Mr. Renner says, find themselves in a "double bind . . . They can say, 'I have to memorize it,' or 'the hell with it.' " More and more students, he suggests, are choosing the latter alternative.

"I do respect the research and feel that the idea is fundamental that students have to be able to think abstractly and have the mental structures required before science can have any meaning," says Mr. Yager. "I do know that most of what we teach in this regard tends to be rote memory. Students learn a definition, and teachers think, 'Aha, they understand it,' but the truth of the matter is, for many students, that's just game playing. That, too, can do damage in the long run, because those who can fill in the blanks are not the best scientists. The winners of the system are not necessarily the best."

STRESS ON APPLICATIONS

Another reason for choosing an applied rather than an abstract approach to the science curriculum, educators argue, is that the former provides students with a frame of reference for understanding science by relating it to the world around them.

But although most good science teachers favor more applications, according to Mr. Aldridge, the curriculum materials most commonly used are still based on those developed in the 1960's, which deliberately avoided applied science.

The curriculum designers "were 100-percent opposed to the notion of applications," says Paul deHart Hurd, emeritus professor of education at Stanford University. "Those were eliminated deliberately to make it pure science. They did that, and they did it very well."

"All the mainline curriculum efforts got rid of applications" in the 1960's, says Mr. Yager. "It's a 180-degree turn now from where we were in 1965. Now, most thinking is that applications are in. We took out refrigerators and televisions—all of that was bad. That was that elitism—we're after biochemists, to hell with the auto mechanics."

"Knowing basic concepts, showing interest, doing something, furthering interest" are goals of many reform-minded science educators

1982-83 Science Teacher Profile

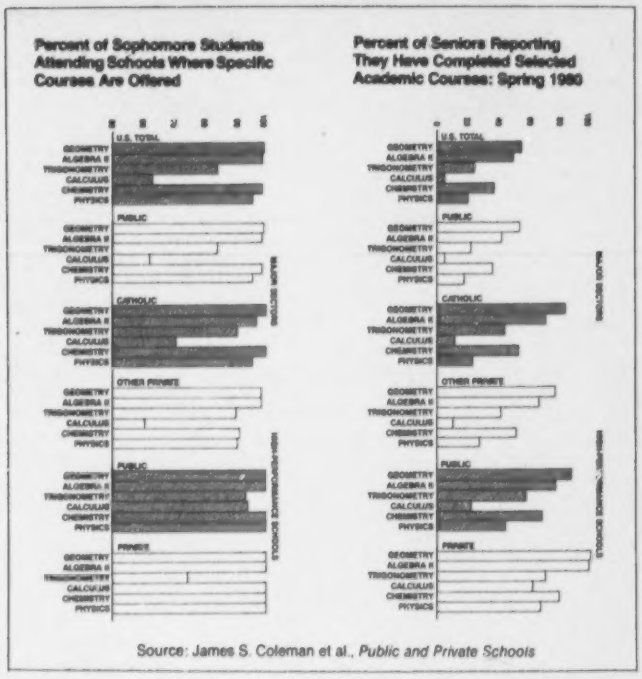
Mean age of teachers	41.6 years
Mean years of teaching experience	16.7 years
Mean years of science teaching experience	16.3 years
Mean percent of class preparation time	10.9%
Percent expressing need for national curriculum development	52%
Percent expressing need for more appropriate science texts	53%
Percent expressing need for more appropriate teaching materials	60%

Career plans for next five years:

1. Remain in classroom	66%
2. Move to administration	5%
3. Move to College teaching	1%
4. Pursue full time graduate studies	1%
5. Retire	8%
6. Change careers	14%

*Based on NSTA Survey of teachers with science teaching load of 50% or more.

BEST AVAILABLE COPY



Source: James S. Coleman et al., *Public and Private Schools*

today, says Mr. Yager. "If anything, a school program ought to be designed to increase interest."

The emphasis on applications, science educators argue, should be infused into the entire secondary-school science curriculum.

Currently, most junior-high students take courses in general science or, in some cases, earth sciences. The goal of those courses is to provide an overview of many topics. But by covering too much material too quickly, the courses may backfire, causing more frustration than satisfaction.

"[It] tends to be a smattering of everything," says Mr. Aldridge of the general-science courses. "It's worse than high school. The material is compressed into a few days; there's no hierarchy."

Instead, he and other experts propose that the learning strategy initiated at the elementary level—the focus on building understanding through experience and observation—be continued on into the upper grades.

According to the science-education conference report, "Concrete experiences should be used to build on and further develop the basic skills of science introduced in the elementary grades."

"Though the emphasis of the program should focus on concrete experiences," the report says, "problem solving and logical reasoning experiences should be interwoven so that students can ask questions, manipulate variables, and make generalizations and develop concepts."

"Continue observations," says Mr. Aldridge. "There are things that become more complex. Look at unusual phenomena. Students can be starting to look at how things work," but should not be given detailed explanations.

"The important thing at the junior-high level is to get them to focus on things of strong personal interest," Mr. Aldridge says. "You wouldn't want to do [a course on] science and society at that stage."

The conference report also urges that junior-high science use an "integrated or unified approach which covers earth, physical, life, and health sciences during the year." Mr. Aldridge and others suggest that topics such as musical acoustics, lasers, and human physiology provide a good framework for teaching the concepts of science to young adolescents.

Most students now take biology in 10th grade. Many go no further; those who do usually take chemistry in the 11th grade, and physics—if anything—in the 12th grade. Although some states have recently started requiring students to take more than one year of science, many continue to demand only a year.

The modifications to the current high-school program being urged by those in the field include changes in both content and sequence; they want both "more *and* different" courses. As with mathematics, reformers agree that simply requiring more of the same, without considering what kind of program would best serve a wide range of students, is not particularly useful.

"There needs to be some very careful consideration of what gets done," says Mr. Hurd, citing the 18 or so states that have recently doubled their science requirements. "What does this do? We don't have qualified teachers, so it compounds the teacher shortage. Two years of doing what is already proving ineffective is compounding the nonlearning. If you double the requirements of science, you're already doubling what kids dislike."

Mr. Hurd once asked a group of students what they thought of increased requirements in science, and one replied that the result would be that "there will be more of us who won't be graduating from high school."

"That's not a very productive educational program," Mr. Hurd says.

INCLUDING TECHNOLOGY

One way to make required science courses more productive for all students, some educators believe, would be to integrate science and technology so that students could see how the fields interact with one another in society. The science-education conference report recommends such courses for students in grades 9 and 10.

Using problems that integrate knowledge from engineering, physics, biology, earth science, and applied mathematics, students would confront material that is "as intellectually demanding as the traditional courses," the report says. "The quantitative and problem-solving aspects will be of a much higher level than what is usually described as a 'general science' course for non-science students," the report says.

Mixing science and technology in one course represents an about-face from the post-Sputnik reforms, when the modest real-world examples were "purged." The former Stanford educator points out that the examples of technology included then—how you plant a field, for example—were "pretty bad." "That's not what modern technology means," he says.

"Modern technology is a social force," Mr. Hurd contends. "In the 1960's and 1970's, science and technology were essentially married. You cannot make a sharp distinction now. We have a general recognition [of] a new paradigm."

By the 11th grade, when many students begin to consider careers, they should have a choice of courses in the various disciplines, with more options added in the 12th grade. The approach to science in these grades can gradually become more abstract, the science-education conference report suggests.

Another proposal that enjoys considerable support would involve teaching all three of the major disciplines each of the three years from the 10th through the 12th grade. Under that system, 10th- and 11th-grade students might spend three periods per week on biology and one each on chemistry and physics; in the 12th grade, the emphasis would shift away from biology, toward chemistry and physics. Alternatively, students might be offered single-semester courses of the various disciplines.

The conference participants agreed, however, that it is important that students take the science-technology sequence. "The conference did not favor the omission of the proposed science-technology sequence in order that advanced-placement courses in the traditional sciences could be reached more rapidly," the report states.

THE DEBATE OVER VALUES

The consensus that is emerging on the desirability of including technology and other applications in science courses does not yet extend into the realm called "values," educators acknowledge.

Some argue that the science classroom is the best place to discuss ethical and social questions related to science, and that "science and society" classes are the best forum for such discussions. "It's the glue," Mr. Yager says of this approach. "It's what makes science meaningful."

But others contend that science teachers must set firm limits on what is germane to their subjects. "Students must learn the difference between science and technology, and the effects of technology on their lives," says Ms. Kahle. "But as far as teaching a course on ecological issues instead of on a whole range of biological issues, I think that has been one thing that has weakened the national test scores."

"You can deal with the science, and go into the topic of acid rain as an application," says Mr. Aldridge of the science teachers' association. "You say to students, 'What we can do is tell you what the scientific component is,' but we've got to stop there. The social and political part has to be dealt with elsewhere. Once you bring it into the classroom, it ceases to be science."

Continued on next page

87% approval rate by chemistry students!
98% approval rate by chemistry teachers!

CHEM MATTERS

A New Publication for High School Chemistry Students from the American Chemical Society

A lively and informative magazine that will bring a new dimension to your chemistry course

Each 16-page issue contains articles on:
- Chemical principles
- Applications of chemistry
- Historical anecdotes
- Computer program information

Also, activities such as:
- Puzzles
- Out-of-school labs
- Special inserts

and much, much more...

The first issue for the 1983 school year will feature A "Close-up" View of Matter by Isaac Asimov

Four exciting issues for a low bulk rate subscription fee of $1.80 per year

(just 45¢ an issue!)—minimum of five subscriptions

Individual subscriptions available at $4.00 per year

Use the attached form and send your order now—don't let your students miss this stimulating addition to their study of chemistry.

Do *not* send money with this order. You will be billed.

Send to: **American Chemical Society**
Chem Matters, Rm. 806
1155 Sixteenth Street, N.W.
Washington, DC 20036, U.S.A.

No. of Subscriptions	Rate	Total
	$1.80 bulk rate (minimum of five subscriptions) $4.00 individual rate	
	California add 6% State Tax	

Shipping Address
Name_____
School_____
School Address_____

Billing Address (if different from above)
_____

P.O. Number_____
Signature_____ Date_____

ED WK

You're Invited!

75th ANNUAL CONFERENCE

RURAL EDUCATION ASSOCIATION

Kansas State University
Manhattan, Kansas
October 16,17,18, 1983

Join the REA and help support the national rural education movement!

For membership information and conference registration materials write:

Rural Education Association
Colorado State University
300 Education Building
Fort Collins, Colorado 80523
(Phone: 303-491-7022)

A Manual for

TEACHER CERTIFICATION IN THE FIFTY STATES

Requirements in All Fifty States

Addresses & Phone Procedures

****

Send $10.00 to:

ROGER E. GODDARD
P.O. Box 128
Grover Hill, Ohio 45849

Lawrence University

Offers scholarly programs leading to M.A. in Education, Ed.D. and Ph.D. in Education, oriented to professional needs of mature, mid-career educators in full-time employment. Degrees are approved by California State Department of Education, Code 94310(b). Recognized by the *Higher Education Directory, 1983*. Academic requirements are met through independent studies and classes. Dissertations are supervised by resident faculty. Research seminars and courses provide intensive, individual advisement by emeriti professors formerly teaching at major accredited universities and school systems. Continuous open enrollment. Write/phone for information: 30 West Mission Street, Santa Barbara, Calif. 93101. (805) 569-1024.

YOU HAVE A MICROCOMPUTER!

QUESTION: What are you going to do with it?

ANSWER: Use the software reviews and teaching techniques found in the

ARITHMETIC TEACHER and MATHEMATICS TEACHER

NCTM

National Council of Teachers of Mathematics
1906 Association Dr. • Reston, VA 22091 • 703/620-9840
Publisher of ARITHMETIC TEACHER & MATHEMATICS TEACHER

NATIONAL SCIENCE TEACHERS ASSOCIATION

The world's largest organization dedicated to the improvement of science teaching

1742 Connecticut Ave. NW • Washington, DC 20009

The Education Commission of the States Announces. . .

ACTION FOR EXCELLENCE

. a comprehensive report on American education with specific recommendations for concerted action by governors, state and local school boards, superintendents, principals, business, industry and labor. .

ecs

For information, call 303-830-3800 or write the Distribution Center, 1860 Lincoln St., #300, Denver, CO 80295

Action for Excellence, 56 pages, is $5. Brochures for specific groups are $1 each or six for $5.

SEARCH: The Science/High Technology Job Report

A monthly detailed listing of a broad range of professional scientific, engineering, computer and related job opportunities with the US Government and other public and private employers in Washington, DC throughout the US, and abroad.

3 months - $25
6 months - $45
12 months - $80

Make check payable to:
Federal Reports, Inc., 1010 Vermont Avenue, N.W., Suite 408
Washington, D.C. 20005. Attn: EW
Or Call (202) 393-3311
Visa/MasterCard

Making the Grade

The Report of the Twentieth Century Fund Task Force on Federal Elementary and Secondary Education Policy

The Report warns that the nation's troubled public schools can be rescued only by a "national commitment to excellence" and sets forth a set of specific recommendations for federal action.

The Report is available along with a comprehensive background paper by Paul E. Peterson. 174 Pages. For your copy of *Making the Grade*, return the coupon with your check or money order for $6.00 to:

The Twentieth Century Fund
41 East 70th Street
New York, New York 10021

Orders for 10 or more copies will be filled at special bulk mailing rates:
10 to 30 copies, $5.50 each — 30 or more copies, $5.00 each

I am enclosing
☐ check ☐ money order
Number of copies_____

Name_____

Address_____

City_____ State_____ Zip Code_____

Continued from previous page

"The whole point about science," he observes, "is that there are many questions that cannot be answered scientifically."

Currently, few districts are teaching science and society courses, according to Mr. Yager, although a number of private schools and some other countries are employing this approach. Consequently, there are few textbooks that integrate social issues with science.

The American Chemical Society is developing a course that some science educators say may serve as a model. The course, "Chemistry in the Community," will consist of one introductory module and eight issue modules. Each will be designed to cover four to six weeks of class time.

The course, designed for students in the 10th through 12th grades, uses "chemical concepts as a basis for helping students understand and consider solutions to a number of current technology-related problems," according to the A.C.S. description of the materials. Topics covered include water, food, petroleum, chemical resources, the chemical industry, and nuclear issues.

The emphasis is on the science that students need to know in order to make decisions about the issues, according to Sylvia Ware, head of educational services for the society and project manager for "ChemComm." Each module includes a "decision-making activity" at the end, which requires students to apply their knowledge to a specific societal problem.

So far, the teachers and students who have used the materials on a test basis have reacted favorably, Ms. Ware said. Teachers report that students are enthusiastic about tackling the societal issues, and some planned to seek further data outside of class to support their positions. The A.C.S. hopes to finish editing the materials by the spring of 1984 and will continue testing them as they are developed.

One concern about "science and society" courses, some educators believe, is that they would be reserved for less able students and would carry a stigma of being second rate.

"This dualism is the worst thing for the science-and-society classes," says Mr. Yager. "We've still got that elitism. We'll end up with nobody in science and society [classes] except those judged average and below. We'll end up with nothing. That would just doom the whole thing."

NEW TEXTBOOKS NEEDED

Because science teachers rely heavily on textbooks, updating them will be a significant impetus, science educators say, in the revival of science in the schools. In biology, where recent discoveries have revolutionized the knowledge base, revisions ought to include much new information, biologists suggest.

And if the shift toward applications catches on, texts that now use an abstract approach to science would have to be rewritten to reflect the new approach. Similarly, science and society courses would require textbooks that link the two topics.

The concept for such books has already been forged, according to Mr. Hurd, at the higher-education level. "How much modification could be made is hard to say, but we do have a lot of models at the college-freshman level," he says of the science and society textbooks. About 1,000 colleges and universities offer courses or programs in science, technology, and society. "We wouldn't be starting from scratch," Mr. Hurd notes.

COMPUTE

Continued from page 19

"photogate" instruments, which measure the acceleration of objects at several points on an "air track," and similar instruments that measure the movement of objects too small for the human eye, the official says.

Because mathematics and science require that students build on their knowledge more than some other subjects, educators say, the computer can be valuable as a "manager" of educational programs. By entering data on student performance, teachers can track students' progress in specific curricular goals—and give special attention to their weaker skills. Teachers can then be assured that students have the skills they need at all levels of activity.

The computer can receive such information in several ways. Some testing programs evaluate the data and indicate which areas should receive special attention. Other programs require special "inputting" of information.

"These [computer programs] can analyze patterns of errors. Worksheets can't do that," says Mr. Powell.

FUNDAMENTAL CHANGES

The computer eventually could lead to fundamental changes in the mathematics and science curricula, the experts note. The computer not only requires greater familiarity with some complex mathematical concepts, they say, but it can also reduce the need for many of the basic computational routines that are usually taught throughout elementary school.

Mr. Powell says students will need to have more advanced mathematics and science backgrounds than their parents. "In Japan, virtually every kid has some kind of calculus," he says.

Jonathan Choate, chairman of the mathematics department at the Groton School, has developed a two-year mathematics curriculum for the computer that teaches high-school students systems dynamics—a subject that he says normally is not taught until college.

Mr. Choate said the course now involves the school's most talented students, but the curriculum soon will be used across the board.

Mr. Tinker of TERC and others say educators should at least partly "prune" several areas from the math and science curricula because of the computer.

Among the topics that Mr. Tinker says he would give less emphasis to are: rote algorithms; fractions; axiomatic geometry; several operations typical in algebra classes, such as root extraction, simultaneous equations, and trigonometric functions; many calculus proofs; and much of the specialized science vocabulary, which he says means little to most students.

"Much of what we now teach in elementary school can now be done with a $5 calculator," says Mr. Kansky. "You could release students for at least half of their time . . . and move on to more problem solving."

PROFILE

Continued from page 10

For their part, science and math teachers say their jobs are not easy. Like Mr. Harris of Seminole County, many are poorly paid and hampered by inadequate budgets. A recent N.S.T.A. survey found that 60 percent of science teachers have had their supplies and equipment budgets cut in the past few years.

One consequence of tight budgets is bigger classes and therefore less individual instruction. "In a 'hands-on' subject like chemistry, where you have to teach kids things as basic as how to hold a test tube, how can you possibly do a decent job with 35 or 40 kids?" asks Mr. Harris. "Two minutes per day per student is not enough."

Other teachers say they must compete with such distractions as part-time jobs for the attention of increasingly disinterested students, and that they get little help from parents.

"When you teach 150 students a day and 20 of them are absent each day and others come in saying things like 'I had to close Wendy's last night, i couldn't get the assignment done,' the learning process slows down. What you planned to cover in one day takes two or three," says Hank J. Ryan, who has taught physics and chemistry at Mounds View High School in suburban Minneapolis for 18 years.

In addition, in a period of sharp enrollment drops in many parts of the country, many senior teachers have shifted from other subjects into math and science under union-backed seniority rules—at the expense of better qualified but less senior math and science teachers.

The result, says F. James Rutherford of the American Association for the Advancement of Science, is that "there are no jobs. In San Francisco they have not hired a teacher in eight years. They have a shortage of math teachers, but they don't hire math teachers."

Ms. Useem of Northeastern University found in her 1982 study, for example, that in four of seven school systems in the Boston area, senior elementary teachers with K-8 certificates had "bumped" less-experienced junior-high math and science specialists. These replacements were clearly less qualified than the specialists they replaced, administrators reported.

"It's hard to see how students are served by such a policy," says Mr. Williams of North Carolina State University.

Finally, a number of school systems, including Pittsburgh's, have reported that there are virtually no math and science teachers on their substitute lists. (Nationally, teachers miss an average of eight days each school year.) But a recent study in North Carolina found that nearly 2,500 people in administrative and other positions in the state's schools are certified to teach math or science but are not doing so.

The shortage of competent math and science instructors is not serious in all subjects or in all areas of the country. Many states report an adequate supply of biology teachers. Small, rural schools typically have a harder time finding science teachers than suburban schools

Also, the U. S. Census Bureau predicts that 75 percent of the expected increase in children ages 5 to 14 will occur in the Southern and Western states, suggesting that the demand for math and science teachers will be greater in those regions.

But many agree with Mr. Howe of Iowa State that the shortage of competent math and science instructors will probably worsen in the next few years. A variety of indicators suggest as much:

•The education schools have graduated fewer and fewer teaching candidates since 1971. Only 20 percent as many math candidates were graduated from Iowa colleges in 1982 as in 1971, according to a recent survey by Mr. Howe and Jack Gerlovich of the Iowa department of education. Only 32 percent as many science candidates were trained. The figures reflect national trends.

Meanwhile, the high-school population has declined nationwide by 15 percent during the past 10 years.

•Many math and science majors are not going into teaching. Only 20 certified math teachers were graduated in Texas last year, and 11 of them took jobs outside teaching. In North Carolina, 50 percent of those trained in math or science in 1980 did not teach, and 30 percent of those who took positions as science teachers did not return for a second year. At the University of Missouri, the largest supplier of teachers in that state, 75 percent of the students certified in math or science in 1981-82 did not go into teaching.

By asking a representative sample of principals how many more classes they would have offered if needed resources and or teachers were available, the N.S.T.A. has estimated that 6,325 full-time teaching positions were unfilled during the 1982-83 school year and that 790,000 students were not offered math and science courses due to a lack of resources and/or teachers.

(Other N.S.T.A. survey information indicates that approximately 16.6 million students were enrolled in math and science courses in grades 8 through 12 nationally during the past school year.)

•The number of 19-to-25-year-

Estimated Supply of Secondary Biology, Chemistry, Physics, General Science, Earth Science, and Mathematics Teachers by State in 1983

State	Biology	Chemistry	Physics	General Science	Earth Science	Math
Alabama*	slight surplus	shortage	critical shortage	adequate	shortage	*no response
Alaska	adequate	adequate	adequate	adequate	adequate	adequate
Arizona	adequate	adequate	adequate	adequate	adequate	shortage
Arkansas	adequate	shortage	shortage	shortage	adequate	shortage
California	shortage	shortage	adequate	shortage	adequate	critical shortage
Colorado*	shortage	shortage	shortage	shortage	shortage	shortage
Connecticut	adequate	shortage	critical shortage	adequate	shortage	shortage
Delaware	slight surplus	adequate	adequate	slight surplus	adequate	shortage
District of Columbia	adequate	critical shortage	critical shortage	adequate	adequate	critical shortage
Florida	adequate	shortage	critical shortage	adequate	shortage	shortage
Georgia	adequate	shortage	shortage	shortage	adequate	adequate
Hawaii	shortage	shortage	critical shortage	adequate	shortage	shortage
Idaho	slight surplus	shortage	shortage	adequate	adequate	shortage
Illinois	adequate	critical shortage	critical shortage	shortage	shortage	critical shortage
Indiana	shortage	critical shortage	critical shortage	critical shortage	critical shortage	critical shortage
Iowa	slight surplus	shortage	critical shortage	adequate	shortage	critical shortage
Kansas	slight surplus	shortage	critical shortage	adequate	shortage	critical shortage
Kentucky	adequate	critical shortage	critical shortage	critical shortage	critical shortage	critical shortage
Louisiana	adequate	shortage	critical shortage	adequate	shortage	shortage
Maine	adequate	shortage	shortage	adequate	adequate/shortage	shortage
Maryland	slight surplus	shortage	critical shortage	critical shortage	critical shortage	critical shortage
Massachusetts*	surplus	adequate	adequate	surplus	surplus	adequate
Michigan	adequate	adequate	shortage	adequate	adequate	shortage
Minnesota	surplus	adequate	adequate	adequate	shortage	adequate
Mississippi	adequate	shortage	critical shortage	adequate	adequate	critical shortage
Missouri	shortage	critical shortage	critical shortage	shortage	critical shortage	critical shortage
Montana	shortage	shortage	shortage	adequate	adequate	shortage
Nebraska	adequate	shortage	shortage	adequate	shortage	shortage
Nevada	slight surplus	shortage	shortage	*no response*	adequate	critical shortage
New Hampshire	adequate	critical shortage	critical shortage	critical shortage	shortage	critical shortage
New Jersey	no response	no response	no response	*no response*	*no response*	*no response*
New Mexico	slight surplus	adequate	shortage	surplus	critical shortage	slight surplus
New York	adequate	shortage	critical shortage	shortage	shortage	shortage
North Carolina	adequate	critical shortage	critical shortage	shortage	shortage	critical shortage
North Dakota	slight surplus	adequate	shortage	adequate	adequate	shortage
Ohio	adequate	critical shortage	critical shortage	shortage	shortage	adequate
Oklahoma	adequate	adequate	adequate	shortage	shortage	shortage
Oregon	adequate	critical shortage	critical shortage	adequate	critical shortage	shortage
Pennsylvania	slight surplus	critical shortage	critical shortage	adequate	shortage	shortage
Rhode Island	slight surplus	adequate	adequate	adequate	*no response*	adequate
South Carolina	shortage	critical shortage	critical shortage	shortage	critical shortage	critical shortage
South Dakota	adequate	critical shortage	critical shortage	adequate	shortage	critical shortage
Tennessee	adequate	shortage	shortage	adequate	adequate	shortage
Texas	surplus	critical shortage	critical shortage	*no response*	shortage	shortage
Utah	adequate	shortage	shortage	adequate	adequate	shortage
Vermont	adequate	shortage	critical shortage	shortage	shortage	shortage
Virginia	surplus	shortage	shortage	surplus	critical shortage	shortage
Washington	adequate	shortage	shortage	adequate	shortage	shortage
West Virginia	no response	no response	no response	*no response*	*no response*	*no response*
Wisconsin	slight surplus	shortage	critical shortage	shortage	adequate	shortage
Wyoming	adequate	adequate	adequate	adequate	adequate	adequate
American Samoa*	shortage	critical shortage	critical shortage	shortage	shortage	shortage
Puerto Rico	slight surplus	critical shortage	critical shortage	adequate	critical shortage	no response

SOURCE: State Department of Public Instruction, Iowa
*1983 data not available, 1982 data shown here.

|I|D|E|A|

Institute for Development of Educational Activities, Inc.

Serving the profession since 1967

|I|D|E|A| is a non-profit organization

- to design and test new responses to problems in education
- to create arrangements for widespread application of these responses

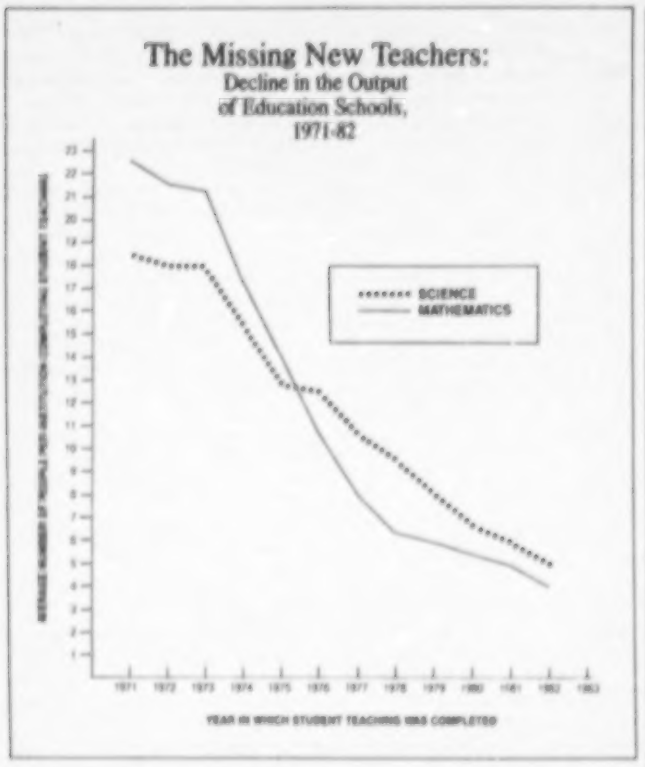
|I|D|E|A| Activities

|I|D|E|A| Fellows Program
Principals' Inservice Program
School Improvement Program
Facilitator Training
Special Seminars

Increasing teacher effectiveness through observation and supervision by peers and by administrators

Involving parents and the entire community to create better learning opportunities for students

5335 Far Hills Avenue, Kettering, Ohio 45429
(513/434-6969)



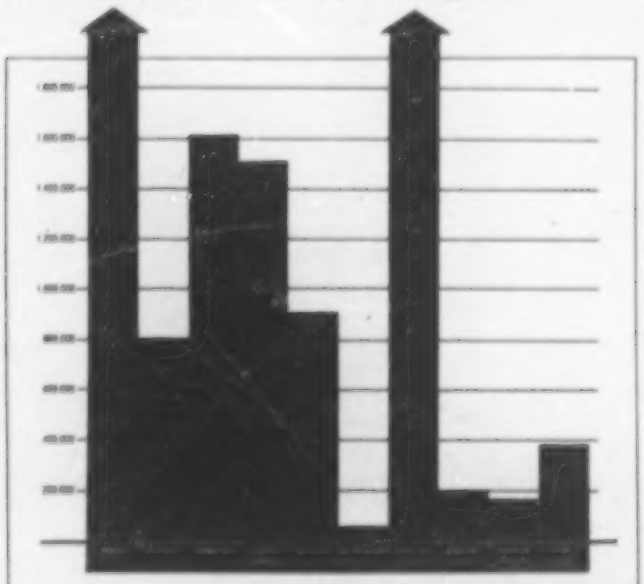
olds, the age group from which most beginning teachers come, will drop by 25 percent in the next 12 years, the Census Bureau reports. In contrast, the school-age population will grow by 5 percent by 1990.

•The salaries of public-school teachers have declined in real terms over the past decade. The average 1982-83 salary of $20,531 buys 12 percent less than the average 1971-72 salary did. According to figures from the American Federation of Teachers, entry-level salaries for New York City teachers in 1982-83 averaged $11,821 for science, math, and engineering graduates, while salaries of graduates with those credentials who went into the private sector averaged $24,500.

•The average age of math and science teachers is high—41.6 years, according to a December 1982 N.S.T.A. survey. The average age of New York City physics teachers is 55, and Ms. Useem found that only 7 of 158 math and science teachers in seven Boston-area school systems are under the age of 30. Many math and science teachers will be retiring within the next decade or so.

•The December 1982 N.S.T.A. survey also found that 2.5 times as many science and math teachers left teaching for other jobs between 1981-82 and 1982-83 than retired. In Mr. Harris's area of Florida, math and science teachers are taking jobs as computer salesmen, stock analysts, supervisors at Disney World, and support personnel in the space program at Cape Canaveral.

But how, as the flow of able science and math teachers into the field seems to be drying up, states are moving to raise either their high-school graduation standards or their college admissions requirements in math and science. It appears that such additional requirements may exacerbate the current shortages of math and science teachers. Says Mr. Aldridge of the N.S.T.A.: "If we think we've got a shortage problem now, wait until school systems try to staff all the new courses that are being mandated."



High-School Students Taking Science Courses, 1982-83

Source: National Science Teachers Association

nte NTE Programs

• Tests to assist in the selection and certification of educational professionals

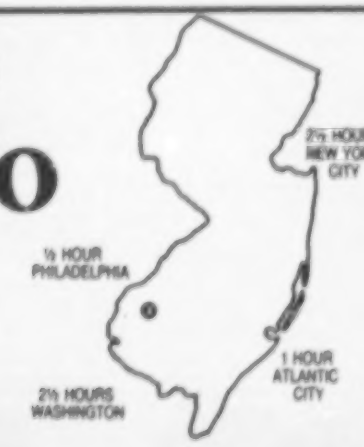
3 Core Battery Tests:
Communication Skills
General Knowledge
Professional Knowledge

27 Specialty Area Tests–
Certification in area of specialization for teachers, administrators, speech and hearing specialists, and other educational professionals

• Publications and services to enhance the selection, training, and certification of qualified professionals
– all publications, forms, and materials needed for testing
– test center and special administration services
– test scoring and reporting
– investigation and complaints and irregularities
– validation studies
– item summary workshops

For further information contact:
NTE Programs
Educational Testing Service
Box 911
Princeton, N.J. 08541

Come To Glassboro State College!



The site of the 1968 Summit Meeting. . .
The site of quality, innovative teacher education programs. . .

EARLY CHILDHOOD. ELEMENTARY MIDDLE. SECONDARY SCHOOL LEVELS

★ **Undergraduate Programs** leading to teacher certification for more than 25 fields, including Physical Science, Earth Science, Biology, Comprehensive Science, Mathematics, and Data Processing

★ **Post-baccalaureate Certification Programs** (for initial or additional teaching certification) in 28 fields including Mathematics, the Sciences, Vocational-Technical Education

★ **Post-baccalaureate Achievement Certificates** (for graduates with teacher certification) includes 18 semester hours of advanced study for mastery in:
☆ **Elementary School Mathematics Teaching, K-8**
☆ **Computers in Education, K-12**
(special tracks for teachers, for administrators)
☆ **Elementary School Language Arts Teaching, K-8**

★ **Master of Arts Degree Programs** in 23 fields including Science and Mathematics teaching

★ **Specialist Level Programs** in Learning Disabilities and Reading

Especially attractive programs for Summer Study and Sabbatical Leaves!

Glassboro State College is accredited by NASDTEC, NCATE, MIDDLE STATES and is an equal opportunity, affirmative action institution.

FOR FURTHER INFORMATION CONTACT: DIVISION OF PROFESSIONAL STUDIES
GLASSBORO STATE COLLEGE · GLASSBORO, NJ 08028 · (609) 445-5241

R4800-2.2

MERIT PAY
New laws in California and Florida, emerging programs in several school districts, and various proposals at the state and federal levels indicate that the movement to link teachers' salaries to performance is taking on a life of its own.
See Page 5.

STUDENT INTEREST
Based on an analysis of test scores, educators have concluded that a decline in the academic performance of Illinois students since 1970 results more from their home environments and their lack of motivation than from factors in school.
See Page 8.

BIBLE STUDY
A federal judge has ruled that Bible classes in a Virginia elementary school are unconstitutional as now operated, but can be continued if they are brought under the school board's control, do not attempt to indoctrinate, and are made voluntary.
See Page 9.

EDUCATION WEEK

American Education's Newspaper of Record Volume II, Number 40 · August 17, 1983

© 1983 Editorial Projects in Education

Justice Dept. Backs Narrow Reading of Title IX

By Tom Mirga

WASHINGTON—The Reagan Administration was harshly criticized last week for its decision to argue before the Supreme Court for a narrow interpretation of the law that aims to bar sex discrimination in education.

Numerous civil-rights groups issued statements castigating the Administration for its position, which was outlined in a legal brief filed with the Court on Aug. 5 in *Grove City College* v. *Bell*. In addition, a bipartisan group of 47 representatives and three senators filed an unusual "friend-of-the-court" brief with the Court last week arguing that the Administration's stance seriously misinterprets the intent of the law, Title IX of the Education Amendments of 1972.

At issue in the *Grove City* case is the right of the Education Department to cut off funds to the small, independent college in Pennsylvania because it refuses to sign a statement assuring the government that it will not practice gender discrimination.

College Questions Compliance

The college contends that it does not have to comply with Title IX, which prohibits any educational "program or activity" receiving federal financial assistance from discriminating on the basis of sex, because it receives no aid directly. The government argues that the law applies to the college because some of its students receive federal tuition grants.

The dispute between the civil-rights groups and the Administration centers on the Administration's interpretation of the "program or activity" clause in the statute.

Previous administrations have contended that when a school or college receives any amount of federal aid of any type, the institution itself is the "program or activity" receiving aid and, therefore, it must comply with the law universally.

But in the brief that it filed with the Court last week, the Reagan Justice Department rejected that longstanding position and said that the college need only comply with Title IX in its financial-aid department because that department is the only direct recipient of federal aid.

"The 'education program or activity' that receives these federal grants is the college's financial aid program, and it is that pro-

Continued on Page 17

New Jersey's High Court Strictly Limits Student Searches

Invalidates Evidence in Two Students' Drug Cases

By Tom Mirga

The New Jersey Supreme Court ruled in two cases last week that the Fourth Amendment protects students from unreasonable searches and seizures while they are in school.

In doing so, the state's highest court invalidated evidence that two students were selling drugs in their high schools. In the first case, *State in the Interest of T. L. O.*, school officials obtained evidence after searching a 14-year-old girl's purse that she was selling marijuana to other students. In the second case, *State of New Jersey* v. *Engerud*, officials used a pass key to open the locker of an 18-year-old student and obtained evidence that he was selling methamphetamine.

According to the court's ruling, handed down on Aug. 8, the students' right to privacy outweighed "the schools' obligation to maintain order."

Furthermore, the court established a new three-part test that New Jersey school officials must use in the future to determine whether a search is permissible. Under that test, the problem must be "prevalent and serious," it must be urgent, and the justification for the search must be based on significant and reliable information.

Gwendolyn H. Gregory, deputy legal counsel for the National School Boards Association, called the court's decision "unfortunate," adding that "it would not appear to protect the interests of children."

"There is no degree of unanimity in these types of cases at either the federal or state court levels," Ms. Gregory said. "It's difficult to find a common thread. But I think it would be fair to say that, at least in the cases of lockers, courts will lean toward the point of view of the schools, particularly if

Continued on Page 17

Reduction-in-Force Is Viewed as an Administration Attack on E.D.

By Eileen White

WASHINGTON—A plan by the Reagan Administration to eliminate more than 100 positions in the 5,200-person Education Department, and to reorganize certain offices, has prompted criticism from members of Congress and from the union representing department employees.

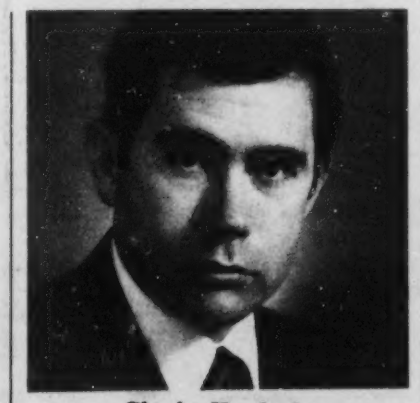
The reduction-in-force, which would affect personnel who administer the Chapter 1 program, vocational education, migrant education, impact aid, Indian education, and the women's educational equity program, is characterized by Administration officials as a way to eliminate "top-heaviness" in the management ranks and to meet personnel ceilings imposed by the federal Office of Personnel Management.

But House members have charged that the planned staff reductions are the first step in an attempt by the Administration to eliminate the department through administrative procedures, after the Congress refused to do so legislatively. The department, they pointed out, has already lost 25 percent of its staff since President Reagan took office, mainly through a hiring freeze, retirements, and attrition.

Program Reorganization

At a hearing earlier this month, Representative William Ford, Democrat of Michigan, told a panel of Administration representatives that "one person's reorganiza-

Continued on Page 11



Charles Heatherly

New York Regents Take a First Step Toward Reform

Endorse Extended Year, Tougher Requirements

By Charlie Euchner

The New York Board of Regents last month gave preliminary approval to a set of proposals that would produce significant changes in the state's education system—including an increase in graduation requirements in all major subjects, more frequent testing of students, a longer school year, and higher standards for teachers.

The Regents will hold 10 meetings across the state this fall to hear public comments on the measures and will take final action next February or March. The state could begin phasing in the wide-ranging changes as early the fall of 1984, officials said.

Gov. Mario M. Cuomo and the state legislature will have to approve any programs that require additional funding. One teachers' organization has estimated that the reforms could cost New York schools an additional $1 billion annually.

Commissioner of Education Gordon M. Ambach said he will have cost estimates for the package ready by next year. "I'm very optimistic about the legislature," he said. "I believe that what the legislature is looking for is a way to connect additional funds to program changes."

Mr. Ambach said the legislature showed a willingness to increase its role in education by increasing state aid to local districts by $1.2 billion over the last four years, despite fiscal problems.

Course Requirements

The plan, which would be phased in over the next 12 years, calls for students to take at least one more course in mathematics, science, and social studies; current policies require one year of mathematics, one year of science, and three years of social studies. Students seeking the Regents's honors diploma would be required to take additional courses in both mathematics and science.

All students also would be required for the first time to take courses in the arts, show proficiency in a foreign language, and demonstrate an ability to use computers in several applications.

Students would take more state-mandated examinations, including four new tests in social studies, two new tests in science, and one new test in a foreign language. Occupational-education students, for the first

Continued on Page 17

THE NEWS IN REVIEW

In Summary

Gathering Momentum
Merit-pay plans have passed in Florida and California and are under consideration at federal, state, and local levels. **Story on Page 5.**

Significant Action
Legislatures in several states have acted on collective-bargaining issues this summer. **Story on Page 6.**

E.T.S. Passes a Test
The testing organization's method of invalidating the test scores of students suspected of cheating is upheld in court. **Story on Page 6.**

No Thirst for Knowledge?
Students' performance in Illinois has declined since 1970, and analysts say lack of motivation is the main reason. **Story on Page 8.**

A Decision in Bristol
A federal judge says Bible classes are permissible if they are optional, objective, and controlled by the school board. **Story on Page 9.**

Paying the Bill in Chicago
Congress has voted to let the Education Department use student-loan funds to pay school-desegregation costs. **Story on Page 10.**

Customized Skills Training
Twenty states now have "quick-start" programs to train vocational students for new and expanding industries. **Story on Page 10.**

Education for the Handicapped
Members of a Senate subcommittee have criticized the Education Department's annual report on P. L. 94-142. **Story on Page 10.**

Tax Deductions for Tuition
In *Mueller* v. *Allen*, the Supreme Court for the first time approved tuition relief for private-school students. **Full Text on Pages 12-15.**

Trading Places
More than 150 U. S. teachers will spend next year in a foreign country under the Fulbright Teacher Exchange Program. **Story on Page 16.**

Appointments	22	In Federal Agencies	10
Colleges Column	9	Letters	20
Commentary	18 and 24	Marketplace	23
Databank	16	New Bills	10
Deadlines	22	Publishing Column	21
Events	22	Washington News	10

EDUCATION WEEK (ISSN 0277-4232) is published 42 times per year (weekly except for the first week in January, the last week in June, the month of July, the first two weeks in August, the last week in November, and the last week in December) by Editorial Projects in Education, Incorporated. Editorial and Advertising Sales Offices located at 1333 New Hampshire Avenue, N.W., Suite 560, Washington, D.C. 20036. (202) 466-5190. Subscriptions: U.S. and Canada: $39.94 for 42 issues. Foreign: $85.94 (airmail) and $56.44 (surface mail) for 42 issues. Second-class postage paid at Washington, D.C. and at additional mailing offices. POSTMASTER: Send address changes to EDUCATION WEEK, P.O. Box 1939, Marion, Ohio 43305. Volume II, Issue 40.

Main Editorial and Business Offices

Suite 560, 1333 New Hampshire Avenue, N.W.
Washington, D.C. 20036
(202) 466-5190

Midwestern Editorial Office
451 The Arcade
Cleveland, Ohio 44114
(216) 241-7320

EDITOR
Ronald A. Wolk

EXECUTIVE EDITOR
Martha K. Matzke

ASSOCIATE EDITORS
Thomas Toch, Susan Walton, Eileen White

STAFF WRITERS
Hope Aldrich, Charlie Euchner, Susan Foster, Alex Heard, Tom Mirga, Sheppard Ranbom

MIDWESTERN BUREAU
Peggy Caldwell

COMMENTARY EDITOR
Thomas Toch

ASSISTANT COMMENTARY EDITOR & SYSTEMS MANAGER
Anne Bridgman

EVENTS EDITOR & COPY EDITOR
Tricia Furniss

ART DIRECTOR
Beth L. Schlemoff

ASSISTANT ART DIRECTOR
Ann Rickerich

EDITORIAL ASSISTANTS
Ann Rickerich
Pamela Winston

CIRCULATION MANAGER
Rhonda J. Sucher

ASSISTANT TO PUBLISHER
Jeff Ranbom

PUBLISHING CONSULTANT
Lawrence A. Durocher Jr.

BOOKKEEPER
Lorna Green

PRODUCTION ASSISTANT
Libby Hatch

STUDENT INTERN
Pamela G. Pitt

DISPLAY ADVERTISING

East Coast and Midwest
Director
Leslie K. Hubbard
Assistant Director
Frances Gibel
Suite 560
1333 New Hampshire Avenue, N.W.
Washington, D.C. 20036
202/466-5190

ADVERTISING SALES REPRESENTATIVE

West Coast, Oklahoma, and Texas
Jan Shere
1507 Bonnie Doone Terrace
Corona del Mar, California 92625
714/640-5689

Grants to help establish *Education Week* have been made by the following philanthropic foundations: Atlantic Richfield Foundation, Mary Reynolds Babcock Foundation, Carnegie Corporation of New York, Cleveland Foundation, Denver Foundation, Geraldine R. Dodge Foundation, E.I. du Pont de Nemours & Co., Exxon Education Foundation, Faye McBeath Foundation, Frost Foundation, George Gund Foundation, Hartford Foundation for Public Giving, Kettering Family Fund, Esther A. and Joseph Klingenstein Fund, Lilly Endowment, William Penn Foundation, Permanent Charities Fund of Boston, Sid W. Richardson Foundation, Rhode Island Foundation, San Francisco Foundation, Shell Companies Foundation, The Tinker Foundation.

SUBSCRIPTION RATES IN U.S. AND CANADA

One year (42 issues). . .$39.94. Outside the U. S. and Canada. . .$56.44 per year for surface mail and $85.94 per year for airmail. Send subscription correspondence to: Education Week, P.O. Box 1939, Marion, Ohio 43305.

Back issues are available at $1.71 each (including 71¢ for first class postage). Send order to: Back Issues, Education Week, Suite 560, 1333 New Hampshire Avenue, N.W., Washington, D.C. 20036.

Subscriptions and Changes of Address
Post Office Box 1939
Marion, Ohio 43305

Federal

President Approves Funding Increases For Three Programs

President Reagan late last month approved a funding bill that increases the fiscal 1983 appropriations for educating disadvantaged and handicapped children and for the school-lunch program.

The measure, approved on July 30, boosts funds for special-education grants to the states by $970 million, for special-education resource centers by $1.2 million, and for "centers for independent living" by $2.1-million.

It also includes an additional $40-million for the $3.2-billion Chapter 1 program for educationally disadvantaged students. The funds are to be used to offset the loss to numerous states this fall, when the Education Department begins allocating Chapter 1 funds on the basis of 1980 census data.

The funds for special education and Chapter 1 will affect schools' programs in the 1983-84 school year. For the school-lunch program, the bill adds $118 million to the $3-billion already spent on school meals this fiscal year. The money will be used to reimburse schools for funds spent in the 1982-83 school year.

Demand for Loans Expected To Rise

Borrowing under the $6.2-billion federal Guaranteed Student Loan Program is expected to increase by 25 percent, to $7.7 billion, in fiscal 1983, according to new estimates by the Office of Management and Budget.

Analysts say that demand for student loans may be spurred by higher college costs, the weak economy, and better public understanding of new eligibility rules for the program.

Last year, when more stringent eligibility rules were established, borrowing declined by 20 percent, from $7.8 billion to $6.2 billion.

This month, the U. S. Education Department announced that interest charged on the guaranteed loans will drop from 9 to 8 percent in September. The lower rates will apply only to students who are borrowing under the loan program for the first time.

The change stems from a 1980 law that requires the interest to drop to 8 percent if the rate paid on U. S. treasury bills is less than 9 percent in the course of a year.

House Panel Affirms Strong Commitment To School Quality

Following the report of the National Commission on Excellence in Education, the House education subcommittee has approved a resolution that reaffirms the federal government's role in education.

The measure, which will be taken up by the full Education and Labor Committee after the August recess, expresses the "sense of the House" that the federal government should set national priorities in education and support programs through the Education Department for disadvantaged precollege and college students.

The measure was approved early this month, as the chairman of the committee, Representative Carl D. Perkins, Democrat of Kentucky, released the results of a survey of members of the commission.

Of the commission's 18 members, 10 had responded to the survey. Eight of those who responded said the commission's report calls for more federal funding for education, according to Representative Perkins.

The survey, and the resolution, are designed to counter the Reagan Administration's efforts to "reverse" the growth of the federal role in education "at the very moment that a rededication to the needs of education is most urgently required," Representative Perkins said.

Wirth Introduces Bill To Promote Computer Literacy

A bill introduced last week by Representative Timothy E. Wirth, Democrat of Colorado, would appropriate $3.2 billion in grants over the next 10 years to promote "computer literacy" in schools.

The main component of the bill would provide $300 million annually to the Education Department to distribute to states for computer hardware purchases. State departments of education would distribute the funds.

No school with more than one computer for every 30 students would be eligible for grants.

Another $20-million annual appropriation would provide grants to states for training teachers and administrators to use computers.

The bill also calls for the National Institute of Education and the National Science Foundation to evaluate hardware and software that schools plan to purchase with the grants.

The bill, which has been referred to both the Education and Labor Committee and the Science and Technology Committee, has 46 cosponsors, an aide to Representative Wirth said.

The aide said the bill does not include money for developing software because the hardware purchases "would be creating a tremendous market" for software manufacturers.

Private Schools Ordered To Seek Minority Teachers

In the wake of the recent U. S. Supreme Court decision barring tax breaks for racially discriminatory schools, a federal judge in Washington, D. C., has ruled that private religious schools in Mississippi must recruit minority faculty and staff members in order to qualify for tax-exempt status.

In the case, *Green* v. *Regan*, U. S. District Judge George L. Hart also rejected the claim of the Clarksdale Baptist Church that the Internal Revenue Service's inspection of school admissions records would violate church officials' First Amendment rights.

The ruling was based on the Supreme Court's rejection of First Amendment claims by two educational institutions in *Bob Jones University* v. *United States*.

The decision, in the *Green* case, which was brought as a class action in 1969, would require affirmative action in admissions and hiring by private religious schools throughout Mississippi.

The ruling will be appealed, according to the schools' attorney, William B. Ball, who also represented Bob Jones University.

R.I. Suit Challenges Transfer of Funds To Church Schools

A U. S. District Court this fall will hear a challenge to Rhode Island's practice of distributing block-grant money to church-affiliated schools, but the court refused to stop distribution of the money before the trial is completed.

State affiliates of the American Civil Liberties Union and the National Education Association and 12 taxpayers filed suit to block distribution of money to private schools. Private schools used $350,000 of the state's $2.2 million in Chapter 2 money last year, according to an official in the state's department of education.

The A.C.L.U. has charged that the materials bought by the private schools can be used for religious instruction and therefore the purchases were in violation of the establishment clause of the U. S. Constitution.

Both Rhode Island and the U. S. Education Department were named as defendants.

The state this year requires private schools to declare that they will not use materials bought with Chapter 2 funds in sectarian or ideological instruction, state education officials said. The schools are already required by the federal government to sign a similar statement.